AMBER model 5500

PROGRAMMABLE AUDIO MEASUREMENT SYSTEM

OWNER'S MANUAL

SECTION 4

APPLICATIONS

Issue 07 January 1989

4.0 PROGRAMMING APPLICATION NOTES FOR THE MODEL 5500

The following several pages provide some information and hints to assist the user in preparing controller software to program the 5500 via the GPIB port.

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4.1 MANUAL PARAMETER SELECTION

The 5500 provides, as part of the internal software, a means of selecting the optimal gain setting for the various amplifier stages. This will cause it to attempt to adjust the gain settings if signal levels present at the outputs of each stage are not within the limits required to guarantee the system accuracy. As the signal levels are determined at the output of the stages and then used to correct the actual gain value, we have a classic negative feedback loop around each stage involving the gain block itself, the detector used to measure the output level, and the software which provides the error amplifier function. There are phase shifts associated with each of these elements and compensation is thus required to guarantee the loop stability. This compensation takes the form of a delay that the software waits after changing the gain before it again attempts to measure the output level.

The delays provided to allow disturbances to settle out can often be quite significant in an automated test setup that may be switching inputs and outputs of the device under test. It often happens, however, that the final signal levels present after the disturbance settles will be quite close to those of the last measurement pass. For this reason the 5500 provides a means to inhibit the automatic selection of gain for each stage independently.

By freezing the gains, the user may avoid the internal invocation of these delays but incurs certain responsibilities. Although the software will still check for gross error conditions, such as a signal that is seriously over-range, it will generally ignore signals that are under-range, except when measuring the signal at the input amplifier (PGA) in distortion or tracking filter measurement modes. These cases are exceptions because adequate level is required for the tuning circuits to properly lock to the input signal.

A further responsibility that the user assumes is that there will be adequate signal level presented to the final detector to permit measurements of the required accuracy. The detectors provide only about a 14 dB dynamic range for specified accuracy over frequency. Where accuracy specifications may be relaxed, it is often practical to reduce the gains below what the software might conservatively consider optimal. This will allow a larger range of input signals without risking over-range conditions which will cause the software to abort the current measurement cycle. This can also provide a means to allow the measurement of high crest factor signals.

Similarly, it is possible to inhibit the automatic selection of various frequency parameters in the instrument. It is possible to inhibit the automatic selection of RMS detector time constant or notch filter frequency, for example. The decision as to which stages to hold and which to leave in automatic operation must be decided on a case by case basis.

The recommended practice of using the instrument in the triggered modes of operation, while controlling it from the GPIB, provides further control of the situation. It should be observed that while the instrument is awaiting a trigger command it is not actively measuring. Thus it is possible to program some change to the configuration and allow the disturbance to settle before triggering another measurement. This gives the user control over the settling times. One could go a step beyond and imagine that the auto-ranging logic could to some extent be handled in the host controller. This can again be quite useful when measuring signals of high crest factor.

We provide here a list of the settling times that will inhibit measurement after each of the mentioned actions:

PARAMETER CHANGED	**DELAY**
Input amp (PGA)	50 msec
Residual amp (PGB)	150 msec
Detector amp (PGC)	150 msec
State variable filter F_o	200 msec

4.2 MEASUREMENT SYNC SELECTION

The technique used for amplitude measurement in the Model 5500 synchronizes the measurement interval to the zero crossings of the measured AC signal. If a signal of sufficient level is not presented to the zero crossing detector, a watchdog timer provides a means to gracefully end the measurement cycle. This timer, however, provides a delay of 250 milliseconds to allow for worst case synchronization of a 10 Hz signal. At any time that the peak value of the detected signal drops in amplitude below the zero crossing hysteresis, this delay may be encountered.

For the purpose of verifying the setting of the gains at the various amplifiers, the measurement interval is chosen as 10 msec or 1 cycle of the synchronizing signal, whichever is greater. The system will thus acquire the value of >100 Hz signals in approximately 10 msec, as long as there is sufficient level to trigger the zero crossing detector. For seriously under-range signals, the acquisition time stretches out to a software determined value of 50 msec. Note that this delay may be incurred at every attempt to set the gains at each of the three programmable gain stages.

For the majority of test applications, the 5500 will be providing the stimulating signal for the device under test (DUT) in real time. It can thus be presumed that the frequency of the signal presented to the analyzer will be the same as that of the internal generator. "Special Function 37" has been provided to allow the measurement interval to synchronize to the internal generator. (Note that phase shift through the DUT does not invalidate this synchronization.)

When making THD type measurements, the system normally synchronizes to the signal present at the output of the first gain stage (PGA), prior to filtering. Setting "Special Function 37.1" will provide ideal sync for this case as well.

Measurement of IMD will synchronize to the recovered low or difference frequency present in the input signal, unless "Special Function 37.1" is in effect. In this case it will sync to the internal low or difference frequency oscillator.

The frequency display will reflect the effective frequency of the synchronizing signal in all cases except IMD measurements. In this case, if "Special Function 37.0" is in effect (the default case), another measurement will be taken to show the high frequency component of the waveform. This will cause a significant time penalty.

It can thus be recommended that the instrument be set to "Special Function 37.1" whenever the internal generator is providing the stimulus for the DUT in real time. Note that erroneous amplitude readings may be encountered if the frequency of the measured signal is different from that of the internal generator, when 37.1 is in effect, and that the frequency displayed will not reflect the frequency of the input signal.

4.3 DETECTOR SELECTION

The technique used for ripple cancellation in the Model 5500 allows amplitude measurements to be taken without consideration for post filtering the detected signals. It should be realized that certain detector characteristics have internal time constants that cannot be eliminated by this technique. The algorithm inherent in the RMS detector, for example, requires the averaging of the exponentially weighted value of the input signal. Although the time constant chosen is the shortest possible consistent with the accuracy required, it will give rise to a perceptible settling time.

The quasi-peak detector, by CCIR definition, also has a time constant which is considerably longer than a measurement cycle. Any measurement using this detector has to account for the decay rate to provide properly settled values.

The average value detector, on the other hand, has no inherent settling time and, where the measured values may be expressed in these dimensions, provides the fastest possible results. Any apparent settling time observed when using this detector is due to such effects as base line shift caused by the AC coupling time constants in the amplifiers or other similar effects.

In general, settling effects can be minimized by using the 400 Hz high pass filter where the errors introduced will not invalidate the measurement results.

Note that the software will try to set the time constant of the RMS detector to the minimum required for the measured frequency, but because the frequency is determined by zero crossings, certain waveforms (e.g. noise, multi-frequency signals or suppressed carrier modulated waveforms) may give rise to errors in the measured value. For these cases, a means is provided to fix the RMS time constant using "Special Function 29"; see the section in the manual entitled "Detector Speed and Operating Mode". Not found in the manual are the ranges of frequencies covered by each range. These ranges are defined such that the computation errors in the RMS detector will not contribute more than 0.1% to the total error budget. Where accuracy requirements are more relaxed, it is reasonable to fix the RMS detector speed faster than the conservative values chosen by the automatic software speed selection.

These are the ranges available:

RANGE	SPECIAL FUNCTION
10 - 30 Hz	29.2
30 - 100 Hz	29.3
100 - 400 Hz	29.4
400 Hz and up	29.5

It will generally be found that the average detector is the fastest and that, at frequencies above approximately 1 kHz, speed will be enhanced by inserting the 400 Hz high pass filter.

4.4 GPIB USAGE

The IEEE-488 bus or GPIB has become the communications medium of choice for the control of instrumentation and small ATE systems. Many users are confronted by a bewildering array of equipment on their benches that should all work together but find themselves stuck with strange messages like "Error - no listeners detected" or "Bus time out error". This application note will attempt to clarify some of the more rudimentary aspects of implementing a test system that communicates via the GPIB.

The IEEE has published a document, "IEEE Std 488-1978", which is a definitive work that leaves relatively little room for ambiguity but the precision of the document, in a manner similar to that of many legal documents, can seem quite arcane to those unfamiliar with the terminology and practice described. None the less, it is recommended that anyone intending to make serious use of the GPIB obtain a copy for reference; as one becomes more familiar with the bus and its operation, the standard will provide answers to many questions.

We will not attempt here to describe the mechanics of the operation of the bus or some of the more elegant techniques used by people who have become expert in its application. The intent is only to provide some hints on actually getting the 5500 to respond to commands and return data to the controller in a reasonably efficient manner.

4.4.1 BUS TRANSFERS

Most operations involving the 5500 on the bus involve the transfer of strings or groups of characters over the bus, much like the transfers of characters between a computer and a serial terminal. There are some points to keep in mind, however, that are somewhat unique to the GPIB.

Getting down to how it is that characters are actually transferred over the bus, we must quickly clarify a few terms that you will encounter in every description of bus operation. Every information transfer in any system requires that there be a transmitter of information and one or more receivers of this information. For normal character type transfers, the GPIB documents will refer to them as the talker and listeners, respectively. If there is a talker transmitting information to the bus and a listener is listening on the bus, the data transfer will probably take place. The talker does not have to know who is listening and the listener does not have to know who is the talker.

Instruments such as the 5500 are advertised as having certain talker and listener **capabilities**. The 5500 has the capability to both talk and listen, for example. This does not mean that it will somehow automatically both talk and listen if connected to a GPIB cable! Except for a little used mode, talkers and listeners will sit idly on the bus unless they are instructed as to their respective roles. This generally requires the services of a controller, the third type of main element on the bus.

4.4.2 CONTROLLER

The primary role of a controller is to instruct a device with talker capability to present its data to the bus and to instruct one or more listeners to accept the data. For any other talker to transmit data to the bus will require the intervention of the controller who must instruct the new talker that it has the exclusive right to transmit data to the bus. As soon as any talker is given transmission rights on the bus, any other talker must cease talking. Devices with listen capability do not automatically listen to data on the bus, they must be instructed by the controller to do so. Once a device is instructed to listen, it will continue to do so until the controller tells it to stop.

For the controller to instruct a particular device to do something, it must have a means of uniquely identifying each device on the bus. This is achieved by setting some information in the device which will be the "device address" that the device will be known by. Most instruments provide switches on the rear panel for setting the device address although some, such as the 5500, allow the user to specify the address via the front panel.

The only information that all devices always accept are instructions from the controller, which are cleverly encoded on the bus to avoid being mistaken for data. How this is done is not generally of concern to the users as it is handled by the interfaces provided by the manufacturers of the devices.

4.4.3 SRQ

Because a talker cannot just grab the bus to send information, a means is provided in the standard to allow a device with information to transmit, or in need of some service from the controller, to request service without disturbing the orderly progress of bus transactions. This capability is known as the service request function or SRQ and is used by a device with talker capabilities to attract the services of the controller, which must (and generally will) be capable of responding. The controller will normally conduct what is known as a "Serial Poll" of the devices on the bus to see which one(s) are requesting service. The serial poll will return a status byte that will provide some information to help the controller determine what action is required. The serial poll will also cause the requesting device to release the SRQ.

It can be seen that for one device to send information to another will generally require a data producer with the capability to be instructed to become the active talker, a data consumer capable of being instructed to listen, and a controller to do the instructing. This may not always seem clear in a typical instrumentation setup because manufacturers of controllers almost invariably build talk and listen capabilities into their systems. The software documentation may not clearly differentiate between the commands that relate to operation of the functions.

4.4.4 ELEMENTS OF A SYSTEM

To make meaningful use of the 5500 in an automated system will generally require a dedicated controller or a "personal" computer with a GPIB interface. It is assumed that the user is reasonably familiar with the operating system and use of the unit which will be used as the system controller and that for the sake of simplicity, the controller and the 5500 are the only units on the bus. It is also assumed that if the controller is a personal computer with an add-on interface, that the interface has been installed correctly. Amber provides an example of the installation of a National Instruments interface board in an IBM PC; we have found this to be an economical and functional combination.

Although the requirements for programming various GPIB controllers vary from model to model and among manufacturers, there are some guidelines that can be followed to ease the pain of getting a system up and running.

4.4.5 GETTING STARTED

With the 5500 connected to the controller via the appropriate GPIB cable, power up both machines. It is assumed that the default addressing mode and address have not been changed in the 5500. This can be verified on the front panel by using the shift of the "GPIB LCL" key which should show "28-1" on the left display. This means that the 5500 device address is 28 and that the talk and listen capabilities are enabled. See the 5500 manual for explanation.

If the controller software provides a monitor mode, this will assist in getting things going, otherwise you will have to write small programs to exercise the 5500. The controller must put the 5500 in the "remote" state before any data will be accepted. Some controllers require that you do this explicitly by executing some kind of "Remote" command with the device address as an argument, while others automatically assume that this must be done when you attempt to communicate with the device. The next step is to get the 5500 to listen to some command string. Because the 5500 ignores line terminator sequences such as carriage returns and line feeds, almost any output or print type command should work. Note that you must tell the controller to send the string to the 5500's address. Now try to print the string "0.1RC" to address 28 on the bus. The 5500 should click and flash and reset itself to its default settings (all except for the GPIB address and operating mode). If nothing happens at all, things are going to get a little tough. Check in the controller manual for the meaning of any error messages that it reports and prepare for some hours of manual flipping. The 5500 remote light should be on. If not, check the means that the controller uses to put the device into remote. The remote state will usually be referred to as "REMS" or "RWLS" in the controller documentation. Note that the controller has had to instruct its own talker to become active and also had to instruct the 5500 to listen. This will generally be quite transparent to the user.

If you are still with us you probably have the 5500 accepting instructions from the controller and have it listening to the talker that is associated with the controller. The next step is to get the listener associated with the controller to accept information from the 5500. This can usually be accomplished by inputting a string from the 5500 address on the bus and then printing the string on the controller's console. The string should be in scientific notation and represent the value seen on the left display of the 5500. Again, if you get errors or strange results, the problem is probably in your use of the controller software.

If the 5500 will accept strings from the controller's talker and send strings to the controller's listener, you are half way there. At this point you can write small programs to set up a measurement and to collect the measurement results. We will now move on to the subject of getting the system to do this reasonably efficiently.

4.4.6 TYPICAL COMMAND STRUCTURE

We will describe what we think is the most efficient way to set up the controller and the 5500. The functions used will generally be present in all controllers. The data in parentheses and double quotes implies literal strings to be sent as data message; without quotes implies bus commands or states.

1. Place the 5500 in local lockout state (LWLS).
2. Place the 5500 in the remote state (RWLS).
3. Recall the default machine state ("0.1RC", SDC or DCL).
4. Place the 5500 in hold mode ("T1").
5. Flush the 5500 output buffer by reading from it until a timeout condition occurs in the controller.
6. Enable the 5500 SRQ on any condition of output ready ("22.2SP").
7. Send a command string to the 5500 that describes the desired measurement configuration (e.g. "AP 1.5VL IO 01 FR 1000 HZ M1").
8. Trigger a measurement attempt (GET or "CL").
9. Wait for SRQ, either using the interrupt processing of the controller or by periodically conducting serial polls. This is not required but allows other processing to occur instead of waiting on a read.
10. Read the data from the 5500. Note that in the triggered modes of operation, the data **must** be taken, or the the output buffer will fill up and themeasurement process will be put to sleep untilroom is available.
11. Check if the reading is an error or exception by comparing the returned value to 90000E5. If the value is greater than this it is an error or exception. The fourth and fifth digits of the mantissa represent the error code. A measurement exception is usually handled by triggering a new measurement but repeated errors will require some corrective action and would usually require some interactive operator input to continue.
12. If the value is valid it may be used immediately or stored for later processing.
13. If there are more tests to run, send some new command string to the 5500 and go back to step 8, otherwise proceed to step 14.
14. If control is to be returned to the 5500 front panel, take it out of the remote state. The 5500 software will automatically restore the free running mode of measurement ("T0").

It is often important to wait until the measured value converges on a final value before further processing. The 5500 does not presume that it knows how you define a "settled" measurement but produces results as quickly as practical. You may wish to develop some algorithms for qualifying readings. Commonly used routines will require that several readings be within a certain percentage of each other before they are accepted as settled. For amplitude measurements, it may sometimes impose less of a math burden on the host software if dB units are used to output the data and then simple subtractions and compares will define the settling window. Improvements in the execution speed of the algorithm will have a noticeable effect on performance because it will probably be called quite often.

It is possible to have an organic computer perform the settling algorithm. Have the controller's program wait for some specific keyboard input before triggering a measurement. The operator can observe the monitor signal on an oscilloscope and trigger a measurement when it has settled. It is possible to use the "CLEAR" key on the 5500 front panel for this purpose if local lockout has not been set.

4.4.7 ADDITIONAL POINTS

There are some points that may be of interest to you as you become more familiar with the use of the bus. First of all, the 5500 does not support the "END" message. This is often used to indicate the end of a data transmission by asserting the "End or Identify" (EDI) interface line when sending the last byte of data but a peculiarity of the Motorola GPIA chip (as used in the 5500) discourages its use. This is generally of little consequence as the 5500 uses a carriage return line feed sequence to delimit data messages. It does no harm if the host talker asserts END but it should not require it to be used. Instead the host should have line feed specified as its "End of String" (EOS) byte.

Although the 5500 does not use DMA to effect bus transfers, it does use a high priority, buffered interrupt driven routine. This means that it will not hold up the bus with NDAC while it processes previous commands. If the input buffer, which has room for approximately 100 characters, ever becomes full however, it will hold off further input by asserting NRFD until room is available in the buffer. If information is not taken from the output buffer in the triggered modes of operations and data is still input to the input buffer, a deadlock condition can be created. The best way out of a deadlock may involve the big red switch.

It is possible to get into a confusing condition if the 5500 is powered down while in one of the triggered modes of operation or if the machine state is stored while in this mode. If the entire machine state is later recalled from the front panel, the trigger mode will also be recalled but cannot be changed from the front panel. If you find yourself in this situation, recall 0.1 and store it in the offending memories.

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4.5 HP/AMBER GPIB CODE COMPARISON

Hewlett Packard 8903B Audio Analyzer
and
Amber model 5500 Audio Measurement System

GPIB and Special Function Code Comparison Chart

The following tables show the GPIB code correspondence between the HP8903B and the Amber 5500 instruments. The table is presented two ways: first sorted alphabetically by Amber code and secondly, alphabetically by HP code. Both versions contain identical information.

Note that four types of codes are presented here:

COMMANDS:	usually operate independently
PREFIXES:	expect data and a terminator
TERMINATOR:	concludes a data string
SPECIAL FUNCTION:	used to set up a condition

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HP 8903B and Amber 5500 GPIB Code Comparison
Sorted by AMBER code

Command or Function	Type	Amber code	HP code	Remarks
SELECT SIGNAL TO NOISE MODE	COMMAND		S2	Amber requires command sequence
SELECT OUTPUT 600 OHMS QUASI-FLOAT	COMMAND	--	47.0SP	Similiar to Amber P0 Command
SELECT OUTPUT 50 OHMS QUASI-FLOAT	COMMAND	--	47.1SP	Similiar to Amber P2 Command
All Plug-in Filters OFF	COMMAND	--	H0	Similiar to Amber code H0 and L0
Left plug-in Filter ON	COMMAND	--	H1	Similiar to Amber code H1
ENABLE LEFT OPTIONAL FILTER	COMMAND	--	H1	Similiar to Amber code H1
Right Plug-in Filter ON	COMMAND	--	H2	Similiar to other Amber codes
DISABLE ALL LOW PASS FILTERS	COMMAND	--	L0	
SELECT SINAD MODE	COMMAND	--	M2	Amber uses command sequence for SINAD
Automatic Notch Tuning	COMMAND	--	N0	Similiar to Amber code 37.1SP
Notch Hold	COMMAND	--	N1	Similiar to Amber code 37.0SP
SET TO AUTOMATIC	COMMAND	AU	AU	SAME
SELECT DBM DISPLAY UNITS	COMMAND	BM	NOT SUPPORTED	
SELECT INPUT TO B OUTPUT	COMMAND	BO	NOT SUPPORTED	
SELECT DBV DISPLAY UNITS	COMMAND	BV	NOT SUPPORTED	
SELECT SOURCE TO A ONLY	COMMAND	C0	NOT SUPPORTED	
SELECT SOURCE TO B ONLY	COMMAND	C1	NOT SUPPORTED	
SELECT SOURCE TO A + B	COMMAND	C2	NOT SUPPORTED	
SELECT SOURCE TO A - B	COMMAND	C3	NOT SUPPORTED	
CLEAR DISPLAY	COMMAND	CL	CL	SAME
TRIGGER MEASUREMENT (TRIG MODE)	COMMAND	CL	CL	SAME
SELECT RMS DETECTOR	COMMAND	D0	A0	SAME
SELECT AVERAGE DETECTOR	COMMAND	D1	A1	SAME
SELECT QUASI-PEAK DETECTOR	COMMAND	D2	5.7SP	Recent HP serial numbers only
SELECT DC LEVEL MODE	COMMAND	DC		REQUIRES OPTION 008 on 5500
DC LEVEL	COMMAND	DC	S1	Similiar
STEP DOWN/DECREMENT	COMMAND	DN	DN	SAME
INPUT FREQ MEASURE & DETECTOR	COMMAND	F1	NOT SUPPORTED	HP always measures INPUT
Measure OSC Frequency	COMMAND	F0		Similiar to HP code N1
DISABLE HIGH PASS FILTER	COMMAND	H0		HP uses plug-in filters
ENABLE HP FILTER	COMMAND	H1		SAME
SELECT INPUT A	COMMAND	IA	NOT SUPPORTED	
SELECT INPUT B	COMMAND	IB	NOT SUPPORTED	
SELECT INPUT TO A OUTPUT	COMMAND	IO	NOT SUPPORTED	
DISABLE ALL WEIGHTING FILTERS	COMMAND	L0		HP depends on plug-in filters installed
ENABLE 30KHZ LP FILTER	COMMAND	L1	L1	SAME
ENABLE 80KHZ LP FILTER	COMMAND	L2	L2	SAME
ENABLE SPCL FILTER	COMMAND	L3		HP depends on plug-in filters installed
ENABLE PSOPHOMETRIC FILTER	COMMAND	L3		HP depends on plug-in filters installed
ENABLE AUX FILTER 1	COMMAND	L4	NOT SUPPORTED	HP has 4 filters maximum
ENABLE AUX FILTER 2	COMMAND	L5	NOT SUPPORTED	HP has 4 filters maximum
ENABLE AUX FILTER 3	COMMAND	L6	NOT SUPPORTED	HP has 4 filters maximum
ENABLE AUX FILTER 4	COMMAND	L7	NOT SUPPORTED	HP has 4 filters maximum
SELECT LOG DISPLAY UNITS	COMMAND	LG	LG	SAME
SELECT LINEAR DISPLAY UNITS	COMMAND	LN	LN	SAME
SELECT WIDE BAND AC LEVEL MODE	COMMAND	M1	M1	SAME
SELECT WATTS LEVEL MODE	COMMAND	M1WA	19.0	
SELECT THD + N LEVEL MODE	COMMAND	M3	S3	CODES INTERCHANGED
SELECT BP LEVEL VERY WIDE	COMMAND	M4	NOT SUPPORTED	HP does not have narrow band mode
SELECT BP LEVEL WIDE	COMMAND	M5	NOT SUPPORTED	HP does not have narrow band mode
SELECT BP LEVEL MEDIUM	COMMAND	M6	NOT SUPPORTED	HP does not have narrow band mode
SELECT BP LEVEL NARROW	COMMAND	M7	NOT SUPPORTED	HP does not have narrow band mode
SELECT HP LEVEL MODE	COMMAND	M8	NOT SUPPORTED	HP does not have narrow band mode
SELECT LP LEVEL MODE	COMMAND	M9	NOT SUPPORTED	HP does not have narrow band mode
RAPID FREQUENCY COUNT MODE	COMMAND	NOT SUPPORTED	RF	
RAPID SOURCE MODE	COMMAND	NOT SUPPORTED	RS	
SWEEP OFF	COMMAND	NOT SUPPORTED	W0	See Amber option 054
SWEEP ON	COMMAND	NOT SUPPORTED	W1	See Amber option 054
SELECT OUTPUT OFF	COMMAND	O0	NOT SUPPORTED	
SELECT OUTPUT ON	COMMAND	O1	NOT SUPPORTED	

HP 8903B and Amber 5500 GPIB Code Comparison
Sorted by AMBER code

Command or Function	Type	Amber code	HP code	Remarks
SELECT OUTPUT FLOAT MODE	COMMAND	OF	NOT SUPPORTED	
SELECT OUTPUT GND REF MODE	COMMAND	OG	NOT SUPPORTED	
SELECT OUTPUT 600 OHMS BALANCED	COMMAND	P0	NOT SUPPORTED	Similiar to HP 47.0SP (not bal)
SELECT OUTPUT 150 OHMS BALANCED	COMMAND	P1	NOT SUPPORTED	
SELECT OUTPUT 50 OHMS UNBALANCED	COMMAND	P2	--	Similiar to HP code 47.1SP
SELECT PHASE MEASUREMENT MODE	COMMAND	PZ	NOT SUPPORTED	REQUIRES OPTION 009
DISABLE RATIO/RELATIVE	COMMAND	R0	R0	SAME
ENABLE RATIO/RELATIVE	COMMAND	R1	R1	SAME
READ LEFT DISPLAY	COMMAND	RL	RL	SAME
READ MEASURED AMPLITUDE	COMMAND	RL	RR	DISPLAYS REVERSED
READ MEASURED FREQUENCY	COMMAND	RR	RL	DISPLAYS REVERSED
READ RIGHT DISPLAY	COMMAND	RR	RR	SAME
SELECT THD + N RATIO MODE	COMMAND	S3	M3	CODES INTERCHANGED
SELECT CCIF IMD MODE	COMMAND	S4	NOT SUPPORTED	HP does not maesure IMD
SELECT SMPTE IMD MODE	COMMAND	S5	NOT SUPPORTED	HP does not measure IMD
SELECT FREE RUN MODE	COMMAND	T0	T0	SAME
SELECT HOLD MODE	COMMAND	T1	T1	SAME
SELECT TRIGGER IMMEDIATE MODE	COMMAND	T2	T2	SAME
SELECT TRIGGER WITH SETTLING	COMMAND	T3	T3	SAME
STEP UP/INCREMENT	COMMAND	UP	UP	SAME
SELECT VOLTS DISPLAY UNITS	COMMAND	VO	LN	HP may require additional commands
SELECT WATTS UNITS (LEVEL MODE)	COMMAND	WA	--	HP USES SPCL FNCT 19
SELECT 100K OHM INPUT	COMMAND	Z0	--	HP ALWAYS 100K OHM
SELECT 150 OHM INPUT	COMMAND	Z1	NOT SUPPORTED	HP is always 100k ohms
SELECT 600 OHM INPUT	COMMAND	Z2	NOT SUPPORTED	HP is always 100k ohms
SET SOURCE AMPLITUDE INCREMENT	PREFIX	AN	AN	SAME
SET SOURCE AMPLITUDE	PREFIX	AP	AP	SAME
SET SOURCE FREQUENCY INCREMENT	PREFIX	FN	FN	SAME
SET SOURCE FREQUENCY	PREFIX	FR	FR	SAME
SET IMD OFFSET FREQ	PREFIX	IF	NOT SUPPORTED	
SELECT SWEEP START FREQ	PREFIX	NOT SUPPORTED	FA	
SELECT SWEEP STOP FREQ	PREFIX	NOT SUPPORTED	FB	
SET PLOT LIMIT	PREFIX	NOT SUPPORTED	PL	
SET RELATIVE MODE REFERENCE	PREFIX	RE	NOT SUPPORTED	
SET FILTER FREQUENCY	PREFIX	SF	NOT SUPPORTED	
SET FILTER FREQUENCY INCREMENT	PREFIX	SN	NOT SUPPORTED	
Input Level Range 4.76V	SPCL FNCT	--	1.10SP	Ranges are different
Input Level Range 3.00V	SPCL FNCT	--	1.11SP	Ranges are different
Input Level Range 1.89V	SPCL FNCT	--	1.12SP	Ranges are different
Input Level Range 1.19V	SPCL FNCT	--	1.13SP	Ranges are different
Input Level Range 0.754V	SPCL FNCT	--	1.14SP	Ranges are different
Input Level Range 0.476V	SPCL FNCT	--	1.15SP	Ranges are different
Input Level Range 0.300V	SPCL FNCT	--	1.16SP	Ranges are different
Input Level Range 0.189V	SPCL FNCT	--	1.17SP	Ranges are different
Input Level Range 0.119V	SPCL FNCT	--	1.18SP	Ranges are different
Input Level Range 0.0754V	SPCL FNCT	--	1.19SP	Ranges are different
Input Level Range 300V	SPCL FNCT	--	1.1SP	Ranges are different
Input Level Range 189V	SPCL FNCT	--	1.2SP	Ranges are different
Input Level Range 119V	SPCL FNCT	--	1.3SP	Ranges are different
Input Level Range 75.4V	SPCL FNCT	--	1.4SP	Ranges are different
Input Level Range 47.6V	SPCL FNCT	--	1.5SP	Ranges are different
Input Level Range 30.0V	SPCL FNCT	--	1.6SP	Ranges are different
Input Level Range 18.9V	SPCL FNCT	--	1.7SP	Ranges are different
Input Level Range 11.9V	SPCL FNCT	--	1.8SP	Ranges are different
Input Level Range 7.54V	SPCL FNCT	--	1.9SP	Ranges are different
SINAD & SNR display resolution 0.5dB	SPCL FNCT	--	16.0SP	Amber is always 0.01dB resolution

HP 8903B and Amber 5500 GPIB Code Comparison
Sorted by AMBER code

Command or Function	Type	Amber code	HP code	Remarks
SINAD & SNR display resolution 0.01dB	SPCL FNCT	--	16.1SP	Amber is always 0.01dB resolution
DC INPUT RANGE 300V	SPCL FNCT	--	2.1SP	Ranges are different
DC INPUT RANGE 64V	SPCL FNCT	--	2.2SP	Ranges are different
DC INPUT RANGE 16V	SPCL FNCT	--	2.3SP	Ranges are different
DC INPUT RANGE 4V	SPCL FNCT	--	2.4SP	Ranges are different
Display GPIB address in binary	SPCL FNCT	--	21.0SP	See spcl fnct 21.1
Display decimal point DD.DDmV	SPCL FNCT	--	4.6SP	Similiar to Amber 5500 code 30.3
Display decimal point D.DDDmV	SPCL FNCT	--	4.7SP	Similiar to Amber 5500 code 30.3
Display decimal point 0.DDDDmV	SPCL FNCT	--	4.8SP	Similiar to Amber 5500 code 30.3
Detector response Fast RMS	SPCL FNCT	--	5.0SP	Amber code D0 and 29.5SP
Detector response Slow RMS	SPCL FNCT	--	5.1SP	Amber code D0 and 29.3SP
Detector response Fast average	SPCL FNCT	--	5.2SP	Amber code D1 and 29.5SP
Detector response Slow average	SPCL FNCT	--	5.3SP	Amber code D1 and 29.3SP
Notch Tune HOLD	SPCL FNCT	--	6.1SP	Similiar to Amber code 6.1SP
All errors enabled	SPCL FNCT	--	8.0SP	
Disable analyzer errors 12-17, 31 & 96	SPCL FNCT	--	8.1SP	
Disable source errors 18 and 19	SPCL FNCT	--	8.2SP	
Disable both source and analyzer errors	SPCL FNCT	--	8.3SP	
Input Level Range AUTO	SPCL FNCT	1.0SP	1.0SP	SAME
Input Level Range 0dBm	SPCL FNCT	1.10SP	--	Ranges are different
Input Level Range -5dBm	SPCL FNCT	1.11SP	--	Ranges are different
Input Level Range -10dBm	SPCL FNCT	1.12SP	--	Ranges are different
Input Level Range -15dBm	SPCL FNCT	1.13SP	--	Ranges are different
Input Level Range -20dBm	SPCL FNCT	1.14SP	--	Ranges are different
Input Level Range -25dBm	SPCL FNCT	1.15SP	--	Ranges are different
Input Level Range HOLD	SPCL FNCT	1.1SP	NOT SUPPORTED	
Input Level Range +40dBm	SPCL FNCT	1.2SP	--	Ranges are different
Input Level Range +35dBm	SPCL FNCT	1.3SP	--	Ranges are different
Input Level Range +30dBm	SPCL FNCT	1.4SP	--	Ranges are different
Input Level Range +25dBm	SPCL FNCT	1.5SP	--	Ranges are different
Input Level Range +20dBm	SPCL FNCT	1.6SP	--	Ranges are different
Input Level Range +15dBm	SPCL FNCT	1.7SP	--	Ranges are different
Input Level Range +10dBm	SPCL FNCT	1.8SP	--	Ranges are different
Input Level Range +5dBm	SPCL FNCT	1.9SP	--	Ranges are different
Display source settings	SPCL FNCT	10SP	10.0SP	Amber code 10.0SP also accepted
Disable RELATIVE mode	SPCL FNCT	11.0SP	NOT SUPPORTED	Minor differences in RELATIVE modes
Display LEVEL relative reference	SPCL FNCT	11.1SP	--	Similiar to HP code 11.1SP
Display RATIO/RELATIVE reference	SPCL FNCT	11.1SP	11.1SP	Minor differences in RELATIVE modes
Display DISTORTION relative reference	SPCL FNCT	11.2SP	NOT SUPPORTED	
Enter RATIO/RELATIVE mode	SPCL FNCT	11.3SP	11.0SP	
Enable RELATIVE mode using stored reference	SPCL FNCT	11.3SP	11.0SP	
Enable RELATIVE mode using current value	SPCL FNCT	11.4SP	NOT SUPPORTED	
Select OSC as output	SPCL FNCT	12.0SP	NOT SUPPORTED	
Select EXT IN as output	SPCL FNCT	12.1SP	NOT SUPPORTED	
Signal source DEFAULT	SPCL FNCT	14.1SP	NOT SUPPORTED	
Signal source IMD composite	SPCL FNCT	14.2SP	NOT SUPPORTED	
Signal source swept sine	SPCL FNCT	14.3SP	NOT SUPPORTED	
Signal source external input	SPCL FNCT	14.4SP	NOT SUPPORTED	
DC INPUT RANGE 100V	SPCL FNCT	2.0SP	--	
DC INPUT RANGE 10V	SPCL FNCT	2.1SP	--	
DC INPUT RANGE 1V	SPCL FNCT	2.2SP	--	
Left display to GPIB port	SPCL FNCT	20.0SP	--	Similiar to RL command
Right display to GPIB port	SPCL FNCT	20.1SP	--	Similiar to RR command
Display GPIB address in decimal	SPCL FNCT	21.0SP	21.1SP	
GPIB Service request	SPCL FNCT	22.nSP	22.nSP	See manuals for SRQ conditions
Power up in DEFAULT state	SPCL FNCT	23.0SP	NOT SUPPORTED	
Power up in last power down state	SPCL FNCT	23.1SP	NOT SUPPORTED	
Start AUTO CAL sequence	SPCL FNCT	24SP	NOT SUPPORTED	
Display WATTS impedance reference	SPCL FNCT	25.0SP	NOT SUPPORTED	
Display level as WATTS into "nnn" ohms	SPCL FNCT	25.nnnSP	19.NNNSP	

HP 8903B and Amber 5500 GPIB Code Comparison
Sorted by AMBER code

Command or Function	Type	Amber code	HP code	Remarks
Display dBm impedance reference	SPCL FNCT	26.0SP	NOT SUPPORTED	
dBm measurement impedance nnn ohms	SPCL FNCT	26.nnnSP	NOT SUPPORTED	
Post Wght Filter gain AUTO	SPCL FNCT	27.0SP	NOT SUPPORTED	
Post Wght Filter gain HOLD	SPCL FNCT	27.1SP	NOT SUPPORTED	
Post Wght Filter gain 0dB	SPCL FNCT	27.2SP	NOT SUPPORTED	
Post Wght Filter gain +10dB	SPCL FNCT	27.3SP	NOT SUPPORTED	
Post Wght Filter gain +20dB	SPCL FNCT	27.4SP	NOT SUPPORTED	
Narrow band tune to OSC	SPCL FNCT	28.0SP	NOT SUPPORTED	
Narrow band tune to INPUT	SPCL FNCT	28.1SP	NOT SUPPORTED	
Detector speed AUTO	SPCL FNCT	29.0SP	--	Similiar to HP spcl fnct 5
Detector speed HOLD	SPCL FNCT	29.1SP	--	Similiar to HP spcl fnct 5
Detector speed very slow	SPCL FNCT	29.2SP	--	Similiar to HP spcl fnct 5
Detector speed slow	SPCL FNCT	29.3SP	--	Similiar to HP spcl fnct 5
Detector speed fast	SPCL FNCT	29.4SP	--	Similiar to HP spcl fnct 5
Detector speed very fast	SPCL FNCT	29.5SP	--	Similiar to HP spcl fnct 5
Post Notch Gain AUTO	SPCL FNCT	3.0SP	3.0SP	Same
Post Notch Gain HOLD	SPCL FNCT	3.1SP	NOT SUPPORTED	
Post Notch Gain 0dB	SPCL FNCT	3.2SP	3.1SP	
Post Notch Gain +20dB	SPCL FNCT	3.3SP	3.2SP	
Post Notch Gain +40dB	SPCL FNCT	3.4SP	3.3SP	
POST NOTCH GAIN +60dB	SPCL FNCT	3.5SP	3.4SP	
POST NOTCH GAIN +80dB	SPCL FNCT	3.6SP	NOT SUPPORTED	
Amplitude units AUTO	SPCL FNCT	30.0SP	NOT SUPPORTED	
Amplitude units HOLD	SPCL FNCT	30.1SP	NOT SUPPORTED	
Amplitude units Volts	SPCL FNCT	30.2SP	NOT SUPPORTED	
Amplitude units mVolts	SPCL FNCT	30.3SP	NOT SUPPORTED	
Amplitude units µV	SPCL FNCT	30.4SP	NOT SUPPORTED	
Amplitude units Watts	SPCL FNCT	30.5SP	NOT SUPPORTED	
Amplitude units mW	SPCL FNCT	30.6SP	NOT SUPPORTED	
Amplitude units µW	SPCL FNCT	30.7SP	NOT SUPPORTED	
Display decimal point AUTO	SPCL FNCT	31.0SP	4.0SP	
Display decimal point HOLD	SPCL FNCT	31.1SP	NOT SUPPORTED	
Display decimal point DDDD.	SPCL FNCT	31.2SP	4.1SP	Amber 5500 is DDDDD.
Display decimal point DDD.D	SPCL FNCT	31.3SP	4.2SP	Amber 5500 is DDDD.D
Display decimal point DD.DD	SPCL FNCT	31.4SP	4.3SP	Amber 5500 is DDD.DD
Display decimal point D.DDD	SPCL FNCT	31.5SP	4.4SP	Amber 5500 is DD.DDD
Display decimal point 0.DDDD	SPCL FNCT	31.6SP	4.5SP	Amber 5500 is D.DDDD
Frequency display FLOATING	SPCL FNCT	32.0SP	NOT SUPPORTED	
Frequency display HOLD	SPCL FNCT	32.1SP	NOT SUPPORTED	
Frequency display DDDDD.	SPCL FNCT	32.2SP	NOT SUPPORTED	
Frequency display DDDD.D	SPCL FNCT	32.3SP	NOT SUPPORTED	
Frequency display DDD.DD	SPCL FNCT	32.4SP	NOT SUPPORTED	
Frequency display DD.DDD	SPCL FNCT	32.5SP	NOT SUPPORTED	
Frequency display D.DDDD	SPCL FNCT	32.6SP	NOT SUPPORTED	
Frequency display 0.DDDDD	SPCL FNCT	32.7SP	NOT SUPPORTED	
Set instrument GPIB address	SPCL FNCT	33.nnSP	NOT SUPPORTED	"nn" is any valid address
GPIB to TALK and LISTEN	SPCL FNCT	34.0SP	NOT SUPPORTED	
GPIB to LISTEN only	SPCL FNCT	34.1SP	NOT SUPPORTED	
GPIB to TALK only	SPCL FNCT	34.2SP	NOT SUPPORTED	
Display SMPTE IMD ampl mix ratio	SPCL FNCT	35.0SP	NOT SUPPORTED	
SMPTE IMD Ampl ratio 1:1	SPCL FNCT	35.1SP	NOT SUPPORTED	
SMPTE IMD Ampl ratio 1:2	SPCL FNCT	35.2SP	NOT SUPPORTED	
SMPTE IMD Ampl ratio 1:4	SPCL FNCT	35.3SP	NOT SUPPORTED	
SMPTE IMD Ampl ratio 1:10	SPCL FNCT	35.4SP	NOT SUPPORTED	
Frequency tuning sync to INPUT	SPCL FNCT	37.0SP	NOT SUPPORTED	
Frequency tuning sync to OSC	SPCL FNCT	37.1SP	NOT SUPPORTED	
Disable serial interface	SPCL FNCT	38.0SP	NOT SUPPORTED	
Enable serial interface	SPCL FNCT	38.1SP	NOT SUPPORTED	
Display VOLTS load impedance	SPCL FNCT	4.0SP	NOT SUPPORTED	
Set Volts load impedance to "nnn" ohms	SPCL FNCT	4.nnnSP	NOT SUPPORTED	

HP 8903B and Amber 5500 GPIB Code Comparison
Sorted by AMBER code

Command or Function	Type	Amber code	HP code	Remarks
Display dBm load impedance	SPCL FNCT	5.0SP	NOT SUPPORTED	
Set dBm load impedance to "nnn" ohms	SPCL FNCT	5.nnnSP	NOT SUPPORTED	
Notch Tune AUTO	SPCL FNCT	6.0SP	6.0SP	
Notch Tune follow OSC	SPCL FNCT	6.1SP	--	
Phase range ±180°	SPCL FNCT	8.0SP	NOT SUPPORTED	
Phase range 0 to 360°	SPCL FNCT	8.1SP	NOT SUPPORTED	
Hold settings	SPCL FNCT	9.0SP	9.0SP	
Detector response Quasi Peak	SPCL FNCT	D2	5.7SP	
Signal-to-Noise AUTO	SPCL FNCT	NOT SUPPORTED	12.0SP	
Signal-to-Noise 200mS delay	SPCL FNCT	NOT SUPPORTED	12.1SP	
Signal-to-Noise 400mS delay	SPCL FNCT	NOT SUPPORTED	12.2SP	
Signal-to-Noise 600mS delay	SPCL FNCT	NOT SUPPORTED	12.3SP	
Signal-to-Noise 800mS delay	SPCL FNCT	NOT SUPPORTED	12.4SP	
Signal-to-Noise 1.0 S delay	SPCL FNCT	NOT SUPPORTED	12.5SP	
Signal-to-Noise 1.2 S delay	SPCL FNCT	NOT SUPPORTED	12.6SP	
Signal-to-Noise 1.4 S delay	SPCL FNCT	NOT SUPPORTED	12.7SP	
Signal-to-Noise 1.6 S delay	SPCL FNCT	NOT SUPPORTED	12.8SP	
Signal-to-Noise 1.8 S delay	SPCL FNCT	NOT SUPPORTED	12.9SP	
XY Recorder ENABLE plot	SPCL FNCT	NOT SUPPORTED	13.0SP	
XY Recorder DISABLE plot	SPCL FNCT	NOT SUPPORTED	13.1SP	
Minimum time between measurements	SPCL FNCT	NOT SUPPORTED	14.0SP	
Add 1 second between measurements	SPCL FNCT	NOT SUPPORTED	14.1SP	
Sweep resolution 10 points/decade	SPCL FNCT	NOT SUPPORTED	17.0SP	
Sweep resolution 1 point /decade	SPCL FNCT	NOT SUPPORTED	17.1SP	
Sweep resolution 2 points/decade	SPCL FNCT	NOT SUPPORTED	17.2SP	
Sweep resolution 5 points/decade	SPCL FNCT	NOT SUPPORTED	17.3SP	
Sweep resolution 10 points/decade	SPCL FNCT	NOT SUPPORTED	17.4SP	
Sweep resolution 20 points/decade	SPCL FNCT	NOT SUPPORTED	17.5SP	
Sweep resolution 50 points/decade	SPCL FNCT	NOT SUPPORTED	17.6SP	
Sweep resolution 100 points/decade	SPCL FNCT	NOT SUPPORTED	17.7SP	
Sweep resolution 200 points/decade	SPCL FNCT	NOT SUPPORTED	17.8SP	
Sweep resolution 500 points/decade	SPCL FNCT	NOT SUPPORTED	17.9SP	
DC INPUT RANGE AUTO	SPCL FNCT	NOT SUPPORTED	2.0SP	
SINAD range 0 to 18dB	SPCL FNCT	NOT SUPPORTED	7.0SP	
SINAD range 0 to 24dB	SPCL FNCT	NOT SUPPORTED	7.1SP	
Output source impedance 600 ohms	SPCL FNCT	P0	47.0SP	
Output source impedance 50 ohms	SPCL FNCT	P2	47.1SP	
Read LEFT display to GPIB port	SPCL FNCT	RL	20.1SP	
Read RIGHT display to GPIB port	SPCL FNCT	RR	20.0SP	
Display level as WATTS into 8 ohms	SPCL FNCT	WA	19.0SP	
DB UNITS	TERMINATOR	DB	DB	SAME
DBM UNITS	TERMINATOR	DM	DV	Means dBu or dBre on 8903B (ref 0.775V)
DBV UNITS	TERMINATOR	DV	NOT SUPPORTED	
HERTZ UNITS	TERMINATOR	HZ	HZ	SAME
KHZ UNITS	TERMINATOR	KH	KH	SAME
KHZ UNITS	TERMINATOR	KH	KZ	
MILLIVOLTS UNITS	TERMINATOR	MV	MV	SAME
MILLIWATTS UNITS	TERMINATOR	MW	NOT SUPPORTED	
PLOT LOWER LIMIT	TERMINATOR	NOT SUPPORTED	LL	
SPCL SPCL	TERMINATOR	NOT SUPPORTED	SS	
PLOT UPPER LIMIT	TERMINATOR	NOT SUPPORTED	UL	
OHMS UNITS	TERMINATOR	OH	NOT SUPPORTED	
PERCENT UNITS	TERMINATOR	PE	NOT SUPPORTED	
RECALL SET UP	TERMINATOR	RC	NOT SUPPORTED	
SPECIAL FUNCTION (SPCL)	TERMINATOR	SP	SP	
STORE SET UP	TERMINATOR	ST	NOT SUPPORTED	
MICROVOLTS UNITS	TERMINATOR	UV	NOT SUPPORTED	
MICROWATTS UNITS	TERMINATOR	UW	NOT SUPPORTED	
VOLTS UNITS	TERMINATOR	VL	VL	

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HP 8903B and Amber 5500 GPIB Code Comparison
Sorted by HP code

Command or Function	Type	HP code	Amber code	Remarks
SELECT DC LEVEL MODE	COMMAND		DC	REQUIRES OPTION 008 on 5500
Measure OSC Frequency	COMMAND		F0.	Similiar to HP code N1
DISABLE HIGH PASS FILTER	COMMAND		H0	HP uses plug-in filters
ENABLE HP FILTER	COMMAND		H1	SAME
DISABLE ALL WEIGHTING FILTERS	COMMAND		L0	HP depends on plug-in filters installed
ENABLE SPCL FILTER	COMMAND		L3	HP depends on plug-in filters installed
ENABLE PSOPHOMETRIC FILTER	COMMAND		L3	HP depends on plug-in filters installed
SELECT OUTPUT 50 OHMS UNBALANCED	COMMAND	--	P2	Similiar to HP code 47.1SP
SELECT WATTS UNITS (LEVEL MODE)	COMMAND	--	WA	HP USES SPCL FNCT 19
SELECT 100K OHM INPUT	COMMAND	--	Z0	HP ALWAYS 100K OHM
SELECT WATTS LEVEL MODE	COMMAND	19.0	M1WA	
SELECT OUTPUT 600 OHMS QUASI-FLOAT	COMMAND	47.0SP	--	Similiar to Amber P0 Command
SELECT OUTPUT 50 OHMS QUASI-FLOAT	COMMAND	47.1SP	--	Similiar to Amber P2 Command
SELECT QUASI-PEAK DETECTOR	COMMAND	5.7SP	D2	Recent HP serial numbers only
SELECT RMS DETECTOR	COMMAND	A0	D0	SAME
SELECT AVERAGE DETECTOR	COMMAND	A1	D1	SAME
SET TO AUTOMATIC	COMMAND	AU	AU	SAME
TRIGGER MEASUREMENT (TRIG MODE)	COMMAND	CL	CL	SAME
CLEAR DISPLAY	COMMAND	CL	CL	SAME
STEP DOWN/DECREMENT	COMMAND	DN	DN	SAME
All Plug-in Filters OFF	COMMAND	H0	--	Similiar to Amber code H0 and L0
Left plug-in Filter ON	COMMAND	H1	--	Similiar to Amber code H1
ENABLE LEFT OPTIONAL FILTER	COMMAND	H1	--	Similiar to Amber code H1
Right Plug-in Filter ON	COMMAND	H2	--	Similiar to other Amber codes
DISABLE ALL LOW PASS FILTERS	COMMAND	L0	--	
ENABLE 30KHZ LP FILTER	COMMAND	L1	L1	SAME
ENABLE 80KHZ LP FILTER	COMMAND	L2	L2	SAME
SELECT LOG DISPLAY UNITS	COMMAND	LG	LG	SAME
SELECT LINEAR DISPLAY UNITS	COMMAND	LN	LN	SAME
SELECT VOLTS DISPLAY UNITS	COMMAND	LN	VO	HP may require additional commands
SELECT WIDE BAND AC LEVEL MODE	COMMAND	M1	M1	SAME
SELECT SINAD MODE	COMMAND	M2	--	Amber uses command sequence for SINAD
SELECT THD + N RATIO MODE	COMMAND	M3	S3	CODES INTERCHANGED
Automatic Notch Tuning	COMMAND	N0	--	Similiar to Amber code 37.1SP
Notch Hold	COMMAND	N1	--	Similiar to Amber code 37.0SP
SELECT DBM DISPLAY UNITS	COMMAND	NOT SUPPORTED	BM	
SELECT INPUT TO B OUTPUT	COMMAND	NOT SUPPORTED	BO	
SELECT DBV DISPLAY UNITS	COMMAND	NOT SUPPORTED	BV	
SELECT SOURCE TO A ONLY	COMMAND	NOT SUPPORTED	C0	
SELECT SOURCE TO B ONLY	COMMAND	NOT SUPPORTED	C1	
SELECT SOURCE TO A + B	COMMAND	NOT SUPPORTED	C2	
SELECT SOURCE TO A - B	COMMAND	NOT SUPPORTED	C3	
INPUT FREQ MEASURE & DETECTOR	COMMAND	NOT SUPPORTED	F1	HP always measures INPUT
SELECT INPUT A	COMMAND	NOT SUPPORTED	IA	
SELECT INPUT B	COMMAND	NOT SUPPORTED	IB	
SELECT INPUT TO A OUTPUT	COMMAND	NOT SUPPORTED	IO	
ENABLE AUX FILTER 1	COMMAND	NOT SUPPORTED	L4	HP has 4 filters maximum
ENABLE AUX FILTER 2	COMMAND	NOT SUPPORTED	L5	HP has 4 filters maximum
ENABLE AUX FILTER 3	COMMAND	NOT SUPPORTED	L6	HP has 4 filters maximum
ENABLE AUX FILTER 4	COMMAND	NOT SUPPORTED	L7	HP has 4 filters maximum
SELECT BP LEVEL VERY WIDE	COMMAND	NOT SUPPORTED	M4	HP does not have narrow band mode
SELECT BP LEVEL WIDE	COMMAND	NOT SUPPORTED	M5	HP does not have narrow band mode
SELECT BP LEVEL MEDIUM	COMMAND	NOT SUPPORTED	M6	HP does not have narrow band mode
SELECT BP LEVEL NARROW	COMMAND	NOT SUPPORTED	M7	HP does not have narrow band mode
SELECT HP LEVEL MODE	COMMAND	NOT SUPPORTED	M8	HP does not have narrow band mode
SELECT LP LEVEL MODE	COMMAND	NOT SUPPORTED	M9	HP does not have narrow band mode
SELECT OUTPUT OFF	COMMAND	NOT SUPPORTED	O0	
SELECT OUTPUT ON	COMMAND	NOT SUPPORTED	O1	
SELECT OUTPUT FLOAT MODE	COMMAND	NOT SUPPORTED	OF	
SELECT OUTPUT GND REF MODE	COMMAND	NOT SUPPORTED	OG	

**HP 8903B and Amber 5500 GPIB Code Comparison
Sorted by HP code**

Command or Function	Type	HP code	Amber code	Remarks
SELECT OUTPUT 600 OHMS BALANCED	COMMAND	NOT SUPPORTED	P0	Similiar to HP 47.0SP (not bal)
SELECT OUTPUT 150 OHMS BALANCED	COMMAND	NOT SUPPORTED	P1	
SELECT PHASE MEASUREMENT MODE	COMMAND	NOT SUPPORTED	PZ	REQUIRES OPTION 009
SELECT CCIF IMD MODE	COMMAND	NOT SUPPORTED	S4	HP does not maesure IMD
SELECT SMPTE IMD MODE	COMMAND	NOT SUPPORTED	S5	HP does not measure IMD
SELECT 150 OHM INPUT	COMMAND	NOT SUPPORTED	Z1	HP is always 100k ohms
SELECT 600 OHM INPUT	COMMAND	NOT SUPPORTED	Z2	HP is always 100k ohms
DISABLE RATIO/RELATIVE	COMMAND	R0	R0	SAME
ENABLE RATIO/RELATIVE	COMMAND	R1	R1	SAME
RAPID FREQUENCY COUNT MODE	COMMAND	RF	NOT SUPPORTED	
READ LEFT DISPLAY	COMMAND	RL	RL	SAME
READ MEASURED FREQUENCY	COMMAND	RL	RR	DISPLAYS REVERSED
READ MEASURED AMPLITUDE	COMMAND	RR	RL	DISPLAYS REVERSED
READ RIGHT DISPLAY	COMMAND	RR	RR	SAME
RAPID SOURCE MODE	COMMAND	RS	NOT SUPPORTED	
DC LEVEL	COMMAND	S1	DC	Similiar
SELECT SIGNAL TO NOISE MODE	COMMAND	S2		Amber requires command sequence
SELECT THD + N LEVEL MODE	COMMAND	S3	M3	CODES INTERCHANGED
SELECT FREE RUN MODE	COMMAND	T0	T0	SAME
SELECT HOLD MODE	COMMAND	T1	T1	SAME
SELECT TRIGGER IMMEDIATE MODE	COMMAND	T2	T2	SAME
SELECT TRIGGER WITH SETTLING	COMMAND	T3	T3	SAME
STEP UP/INCREMENT	COMMAND	UP	UP	SAME
SWEEP OFF	COMMAND	W0	NOT SUPPORTED	See Amber option 054
SWEEP ON	COMMAND	W1	NOT SUPPORTED	See Amber option 054
SET SOURCE AMPLITUDE INCREMENT	PREFIX	AN	AN	SAME
SET SOURCE AMPLITUDE	PREFIX	AP	AP	SAME
SELECT SWEEP START FREQ	PREFIX	FA	NOT SUPPORTED	
SELECT SWEEP STOP FREQ	PREFIX	FB	NOT SUPPORTED	
SET SOURCE FREQUENCY INCREMENT	PREFIX	FN	FN	SAME
SET SOURCE FREQUENCY	PREFIX	FR	FR	SAME
SET IMD OFFSET FREQ	PREFIX	NOT SUPPORTED	IF	
SET RELATIVE MODE REFERENCE	PREFIX	NOT SUPPORTED	RE	
SET FILTER FREQUENCY	PREFIX	NOT SUPPORTED	SF	
SET FILTER FREQUENCY INCREMENT	PREFIX	NOT SUPPORTED	SN	
SET PLOT LIMIT	PREFIX	PL	NOT SUPPORTED	
Input Level Range 0dBm	SPCL FNCT	--	1.10SP	Ranges are different
Input Level Range -5dBm	SPCL FNCT	--	1.11SP	Ranges are different
Input Level Range -10dBm	SPCL FNCT	--	1.12SP	Ranges are different
Input Level Range -15dBm	SPCL FNCT	--	1.13SP	Ranges are different
Input Level Range -20dBm	SPCL FNCT	--	1.14SP	Ranges are different
Input Level Range -25dBm	SPCL FNCT	--	1.15SP	Ranges are different
Input Level Range +40dBm	SPCL FNCT	--	1.2SP	Ranges are different
Input Level Range +35dBm	SPCL FNCT	--	1.3SP	Ranges are different
Input Level Range +30dBm	SPCL FNCT	--	1.4SP	Ranges are different
Input Level Range +25dBm	SPCL FNCT	--	1.5SP	Ranges are different
Input Level Range +20dBm	SPCL FNCT	--	1.6SP	Ranges are different
Input Level Range +15dBm	SPCL FNCT	--	1.7SP	Ranges are different
Input Level Range +10dBm	SPCL FNCT	--	1.8SP	Ranges are different
Input Level Range +5dBm	SPCL FNCT	--	1.9SP	Ranges are different
Display LEVEL relative reference	SPCL FNCT	--	11.1SP	Similiar to HP code 11.1SP
DC INPUT RANGE 100V	SPCL FNCT	--	2.0SP	
DC INPUT RANGE 10V	SPCL FNCT	--	2.1SP	
DC INPUT RANGE 1V	SPCL FNCT	--	2.2SP	
Left display to GPIB port	SPCL FNCT	--	20.0SP	Similiar to RL command
Right display to GPIB port	SPCL FNCT	--	20.1SP	Similiar to RR command
Detector speed AUTO	SPCL FNCT	--	29.0SP	Similiar to HP spcl fnct 5
Detector speed HOLD	SPCL FNCT	--	29.1SP	Similiar to HP spcl fnct 5

HP 8903B and Amber 5500 GPIB Code Comparison
Sorted by HP code

Command or Function	Type	HP code	Amber code	Remarks
Detector speed very slow	SPCL FNCT	--	29.2SP	Similiar to HP spcl fnct 5
Detector speed slow	SPCL FNCT	--	29.3SP	Similiar to HP spcl fnct 5
Detector speed fast	SPCL FNCT	--	29.4SP	Similiar to HP spcl fnct 5
Detector speed very fast	SPCL FNCT	--	29.5SP	Similiar to HP spcl fnct 5
Notch Tune follow OSC	SPCL FNCT	--	6.1SP	
Input Level Range AUTO	SPCL FNCT	1.0SP	1.0SP	SAME
Input Level Range 4.76V	SPCL FNCT	1.10SP	--	Ranges are different
Input Level Range 3.00V	SPCL FNCT	1.11SP	--	Ranges are different
Input Level Range 1.89V	SPCL FNCT	1.12SP	--	Ranges are different
Input Level Range 1.19V	SPCL FNCT	1.13SP	--	Ranges are different
Input Level Range 0.754V	SPCL FNCT	1.14SP	--	Ranges are different
Input Level Range 0.476V	SPCL FNCT	1.15SP	--	Ranges are different
Input Level Range 0.300V	SPCL FNCT	1.16SP	--	Ranges are different
Input Level Range 0.189V	SPCL FNCT	1.17SP	--	Ranges are different
Input Level Range 0.119V	SPCL FNCT	1.18SP	--	Ranges are different
Input Level Range 0.0754V	SPCL FNCT	1.19SP	--	Ranges are different
Input Level Range 300V	SPCL FNCT	1.1SP	--	Ranges are different
Input Level Range 189V	SPCL FNCT	1.2SP	--	Ranges are different
Input Level Range 119V	SPCL FNCT	1.3SP	--	Ranges are different
Input Level Range 75.4V	SPCL FNCT	1.4SP	--	Ranges are different
Input Level Range 47.6V	SPCL FNCT	1.5SP	--	Ranges are different
Input Level Range 30.0V	SPCL FNCT	1.6SP	--	Ranges are different
Input Level Range 18.9V	SPCL FNCT	1.7SP	--	Ranges are different
Input Level Range 11.9V	SPCL FNCT	1.8SP	--	Ranges are different
Input Level Range 7.54V	SPCL FNCT	1.9SP	--	Ranges are different
Display source settings	SPCL FNCT	10.0SP	10SP	Amber code 10.0SP also accepted
Enter RATIO/RELATIVE mode	SPCL FNCT	11.0SP	11.3SP	
Enable RELATIVE mode using stored reference	SPCL FNCT	11.0SP	11.3SP	
Display RATIO/RELATIVE reference	SPCL FNCT	11.1SP	11.1SP	Minor differences in RELATIVE modes
Signal-to-Noise AUTO	SPCL FNCT	12.0SP	NOT SUPPORTED	
Signal-to-Noise 200mS delay	SPCL FNCT	12.1SP	NOT SUPPORTED	
Signal-to-Noise 400mS delay	SPCL FNCT	12.2SP	NOT SUPPORTED	
Signal-to-Noise 600mS delay	SPCL FNCT	12.3SP	NOT SUPPORTED	
Signal-to-Noise 800mS delay	SPCL FNCT	12.4SP	NOT SUPPORTED	
Signal-to-Noise 1.0 S delay	SPCL FNCT	12.5SP	NOT SUPPORTED	
Signal-to-Noise 1.2 S delay	SPCL FNCT	12.6SP	NOT SUPPORTED	
Signal-to-Noise 1.4 S delay	SPCL FNCT	12.7SP	NOT SUPPORTED	
Signal-to-Noise 1.6 S delay	SPCL FNCT	12.8SP	NOT SUPPORTED	
Signal-to-Noise 1.8 S delay	SPCL FNCT	12.9SP	NOT SUPPORTED	
XY Recorder ENABLE plot	SPCL FNCT	13.0SP	NOT SUPPORTED	
XY Recorder DISABLE plot	SPCL FNCT	13.1SP	NOT SUPPORTED	
Minimum time between measurements	SPCL FNCT	14.0SP	NOT SUPPORTED	
Add 1 second between measurements	SPCL FNCT	14.1SP	NOT SUPPORTED	
SINAD & SNR display resolution 0.5dB	SPCL FNCT	16.0SP	--	Amber is always 0.01dB resolution
SINAD & SNR display resolution 0.01dB	SPCL FNCT	16.1SP	--	Amber is always 0.01dB resolution
Sweep resolution 10 points/decade	SPCL FNCT	17.0SP	NOT SUPPORTED	
Sweep resolution 1 point /decade	SPCL FNCT	17.1SP	NOT SUPPORTED	
Sweep resolution 2 points/decade	SPCL FNCT	17.2SP	NOT SUPPORTED	
Sweep resolution 5 points/decade	SPCL FNCT	17.3SP	NOT SUPPORTED	
Sweep resolution 10 points/decade	SPCL FNCT	17.4SP	NOT SUPPORTED	
Sweep resolution 20 points/decade	SPCL FNCT	17.5SP	NOT SUPPORTED	
Sweep resolution 50 points/decade	SPCL FNCT	17.6SP	NOT SUPPORTED	
Sweep resolution 100 points/decade	SPCL FNCT	17.7SP	NOT SUPPORTED	
Sweep resolution 200 points/decade	SPCL FNCT	17.8SP	NOT SUPPORTED	
Sweep resolution 500 points/decade	SPCL FNCT	17.9SP	NOT SUPPORTED	
Display level as WATTS into 8 ohms	SPCL FNCT	19.0SP	WA	
Display level as WATTS into "nnn" ohms	SPCL FNCT	19.NNNSP	25.nnnSP	
DC INPUT RANGE AUTO	SPCL FNCT	2.0SP	NOT SUPPORTED	
DC INPUT RANGE 300V	SPCL FNCT	2.1SP	--	Ranges are different
DC INPUT RANGE 64V	SPCL FNCT	2.2SP	--	Ranges are different

HP 8903B and Amber 5500 GPIB Code Comparison
Sorted by HP code

Command or Function	Type	HP code	Amber code	Remarks
DC INPUT RANGE 16V	SPCL FNCT	2.3SP	--	Ranges are different
DC INPUT RANGE 4V	SPCL FNCT	2.4SP	--	Ranges are different
Read RIGHT display to GPIB port	SPCL FNCT	20.0SP	RR	
Read LEFT display to GPIB port	SPCL FNCT	20.1SP	RL	
Display GPIB address in binary	SPCL FNCT	21.0SP	--	See spcl fnct 21.1
Display GPIB address in decimal	SPCL FNCT	21.1SP	21.0SP	
GPIB Service request	SPCL FNCT	22.nSP	22.nSP	See manuals for SRQ conditions
Post Notch Gain AUTO	SPCL FNCT	3.0SP	3.0SP	Same
Post Notch Gain 0dB	SPCL FNCT	3.1SP	3.2SP	
Post Notch Gain +20dB	SPCL FNCT	3.2SP	3.3SP	
Post Notch Gain +40dB	SPCL FNCT	3.3SP	3.4SP	
POST NOTCH GAIN +60dB	SPCL FNCT	3.4SP	3.5SP	
Display decimal point AUTO	SPCL FNCT	4.0SP	31.0SP	
Display decimal point DDDD.	SPCL FNCT	4.1SP	31.2SP	Amber 5500 is DDDDD.
Display decimal point DDD.D	SPCL FNCT	4.2SP	31.3SP	Amber 5500 is DDDD.D
Display decimal point DD.DD	SPCL FNCT	4.3SP	31.4SP	Amber 5500 is DDD.DD
Display decimal point D.DDD	SPCL FNCT	4.4SP	31.5SP	Amber 5500 is DD.DDD
Display decimal point 0.DDDD	SPCL FNCT	4.5SP	31.6SP	Amber 5500 is D.DDDD
Display decimal point DD.DDmV	SPCL FNCT	4.6SP	--	Similiar to Amber 5500 code 30.3
Display decimal point D.DDDmV	SPCL FNCT	4.7SP	--	Similiar to Amber 5500 code 30.3
Display decimal point 0.DDDDmV	SPCL FNCT	4.8SP	--	Similiar to Amber 5500 code 30.3
Output source impedance 600 ohms	SPCL FNCT	47.0SP	P0	
Output source impedance 50 ohms	SPCL FNCT	47.1SP	P2	
Detector response Fast RMS	SPCL FNCT	5.0SP	--	Amber code D0 and 29.5SP
Detector response Slow RMS	SPCL FNCT	5.1SP	--	Amber code D0 and 29.3SP
Detector response Fast average	SPCL FNCT	5.2SP	--	Amber code D1 and 29.5SP
Detector response Slow average	SPCL FNCT	5.3SP	--	Amber code D1 and 29.3SP
Detector response Quasi Peak	SPCL FNCT	5.7SP	D2	
Notch Tune AUTO	SPCL FNCT	6.0SP	6.0SP	
Notch Tune HOLD	SPCL FNCT	6.1SP	--	Similiar to Amber code 6.1SP
SINAD range 0 to 18dB	SPCL FNCT	7.0SP	NOT SUPPORTED	
SINAD range 0 to 24dB	SPCL FNCT	7.1SP	NOT SUPPORTED	
All errors enabled	SPCL FNCT	8.0SP	--	
Disable analyzer errors 12-17, 31 & 96	SPCL FNCT	8.1SP	--	
Disable source errors 18 and 19	SPCL FNCT	8.2SP	--	
Disable both source and analyzer errors	SPCL FNCT	8.3SP	--	
Hold settings	SPCL FNCT	9.0SP	9.0SP	
Input Level Range HOLD	SPCL FNCT	NOT SUPPORTED	1.1SP	
Disable RELATIVE mode	SPCL FNCT	NOT SUPPORTED	11.0SP	Minor differences in RELATIVE modes
Display DISTORTION relative reference	SPCL FNCT	NOT SUPPORTED	11.2SP	
Enable RELATIVE mode using current value	SPCL FNCT	NOT SUPPORTED	11.4SP	
Select OSC as output	SPCL FNCT	NOT SUPPORTED	12.0SP	
Select EXT IN as output	SPCL FNCT	NOT SUPPORTED	12.1SP	
Signal source DEFAULT	SPCL FNCT	NOT SUPPORTED	14.1SP	
Signal source IMD composite	SPCL FNCT	NOT SUPPORTED	14.2SP	
Signal source swept sine	SPCL FNCT	NOT SUPPORTED	14.3SP	
Signal source external input	SPCL FNCT	NOT SUPPORTED	14.4SP	
Power up in DEFAULT state	SPCL FNCT	NOT SUPPORTED	23.0SP	
Power up in last power down state	SPCL FNCT	NOT SUPPORTED	23.1SP	
Start AUTO CAL sequence	SPCL FNCT	NOT SUPPORTED	24SP	
Display WATTS impedance reference	SPCL FNCT	NOT SUPPORTED	25.0SP	
Display dBm impedance reference	SPCL FNCT	NOT SUPPORTED	26.0SP	
dBm measurement impedance nnn ohms	SPCL FNCT	NOT SUPPORTED	26.nnnSP	
Post Wght Filter gain AUTO	SPCL FNCT	NOT SUPPORTED	27.0SP	
Post Wght Filter gain HOLD	SPCL FNCT	NOT SUPPORTED	27.1SP	
Post Wght Filter gain 0dB	SPCL FNCT	NOT SUPPORTED	27.2SP	
Post Wght Filter gain +10dB	SPCL FNCT	NOT SUPPORTED	27.3SP	
Post Wght Filter gain +20dB	SPCL FNCT	NOT SUPPORTED	27.4SP	
Narrow band tune to OSC	SPCL FNCT	NOT SUPPORTED	28.0SP	
Narrow band tune to INPUT	SPCL FNCT	NOT SUPPORTED	28.1SP	

HP 8903B and Amber 5500 GPIB Code Comparison
Sorted by HP code

Command or Function	Type	HP code	Amber code	Remarks
Post Notch Gain HOLD	SPCL FNCT	NOT SUPPORTED	3.1SP	
POST NOTCH GAIN +80dB	SPCL FNCT	NOT SUPPORTED	3.6SP	
Amplitude units AUTO	SPCL FNCT	NOT SUPPORTED	30.0SP	
Amplitude units HOLD	SPCL FNCT	NOT SUPPORTED	30.1SP	
Amplitude units Volts	SPCL FNCT	NOT SUPPORTED	30.2SP	
Amplitude units mVolts	SPCL FNCT	NOT SUPPORTED	30.3SP	
Amplitude units µV	SPCL FNCT	NOT SUPPORTED	30.4SP	
Amplitude units Watts	SPCL FNCT	NOT SUPPORTED	30.5SP	
Amplitude units mW	SPCL FNCT	NOT SUPPORTED	30.6SP	
Amplitude units µW	SPCL FNCT	NOT SUPPORTED	30.7SP	
Display decimal point HOLD	SPCL FNCT	NOT SUPPORTED	31.1SP	
Frequency display FLOATING	SPCL FNCT	NOT SUPPORTED	32.0SP	
Frequency display HOLD	SPCL FNCT	NOT SUPPORTED	32.1SP	
Frequency display DDDDD.	SPCL FNCT	NOT SUPPORTED	32.2SP	
Frequency display DDDD.D	SPCL FNCT	NOT SUPPORTED	32.3SP	
Frequency display DDD.DD	SPCL FNCT	NOT SUPPORTED	32.4SP	
Frequency display DD.DDD	SPCL FNCT	NOT SUPPORTED	32.5SP	
Frequency display D.DDDD	SPCL FNCT	NOT SUPPORTED	32.6SP	
Frequency display 0.DDDDD	SPCL FNCT	NOT SUPPORTED	32.7SP	
Set instrument GPIB address	SPCL FNCT	NOT SUPPORTED	33.nnSP	"nn" is any valid address
GPIB to TALK and LISTEN	SPCL FNCT	NOT SUPPORTED	34.0SP	
GPIB to LISTEN only	SPCL FNCT	NOT SUPPORTED	34.1SP	
GPIB to TALK only	SPCL FNCT	NOT SUPPORTED	34.2SP	
Display SMPTE IMD ampl mix ratio	SPCL FNCT	NOT SUPPORTED	35.0SP	
SMPTE IMD Ampl ratio 1:1	SPCL FNCT	NOT SUPPORTED	35.1SP	
SMPTE IMD Ampl ratio 1:2	SPCL FNCT	NOT SUPPORTED	35.2SP	
SMPTE IMD Ampl ratio 1:4	SPCL FNCT	NOT SUPPORTED	35.3SP	
SMPTE IMD Ampl ratio 1:10	SPCL FNCT	NOT SUPPORTED	35.4SP	
Frequency tuning sync to INPUT	SPCL FNCT	NOT SUPPORTED	37.0SP	
Frequency tuning sync to OSC	SPCL FNCT	NOT SUPPORTED	37.1SP	
Disable serial interface	SPCL FNCT	NOT SUPPORTED	38.0SP	
Enable serial interface	SPCL FNCT	NOT SUPPORTED	38.1SP	
Display VOLTS load impedance	SPCL FNCT	NOT SUPPORTED	4.0SP	
Set Volts load impedance to "nnn" ohms	SPCL FNCT	NOT SUPPORTED	4.nnnSP	
Display dBm load impedance	SPCL FNCT	NOT SUPPORTED	5.0SP	
Set dBm load impedance to "nnn" ohms	SPCL FNCT	NOT SUPPORTED	5.nnnSP	
Phase range ±180°	SPCL FNCT	NOT SUPPORTED	8.0SP	
Phase range 0 to 360°	SPCL FNCT	NOT SUPPORTED	8.1SP	
DB UNITS	TERMINATOR	DB	DB	SAME
DBM UNITS	TERMINATOR	DV	DM	Means dBu or dBre on 8903B (ref 0.775V)
HERTZ UNITS	TERMINATOR	HZ	HZ	SAME
KHZ UNITS	TERMINATOR	KH	KH	SAME
KHZ UNITS	TERMINATOR	KZ	KH	
PLOT LOWER LIMIT	TERMINATOR	LL	NOT SUPPORTED	
MILLIVOLTS UNITS	TERMINATOR	MV	MV	SAME
DBV UNITS	TERMINATOR	NOT SUPPORTED	DV	
MILLIWATTS UNITS	TERMINATOR	NOT SUPPORTED	MW	
OHMS UNITS	TERMINATOR	NOT SUPPORTED	OH	
PERCENT UNITS	TERMINATOR	NOT SUPPORTED	PE	
RECALL SET UP	TERMINATOR	NOT SUPPORTED	RC	
STORE SET UP	TERMINATOR	NOT SUPPORTED	ST	
MICROVOLTS UNITS	TERMINATOR	NOT SUPPORTED	UV	
MICROWATTS UNITS	TERMINATOR	NOT SUPPORTED	UW	
SPECIAL FUNCTION (SPCL)	TERMINATOR	SP	SP	
SPCL SPCL	TERMINATOR	SS	NOT SUPPORTED	
PLOT UPPER LIMIT	TERMINATOR	UL	NOT SUPPORTED	
VOLTS UNITS	TERMINATOR	VL	VL	

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4.6 SAMPLE CONTROLLER PROGRAM for an AMBER 5500 PROGRAMMABLE DISTORTION & NOISE MEASUREMENT SYSTEM with an IBM PC

Issue 01: May 1985

This program is offered to purchasers of an Amber 5500 Programmable Distortion & Noise Measurement System to assist the user in writing specific application programs. It is offered on a no charge basis, as is, and without support or warranties.

The program is designed to run on an IBM-PC/XT or equivalent equipped with a National Instruments GPIB-PC interface board and at least 256 k of memory. It assumes the user has the National Instruments documentation and BASICA interpreter and is familiar with BASIC programming.

The program allows the user to set up as many as 100 separate tests, each involving several commands to the 5500 and processing of the measured results. It can test the results for certain limit criteria and provide summarized reports to screen or printer.

The program could be used, for example, to run a complete checkout of a device under test with up to 100 parameters evaluated according to user defined limits.

It is suggested that the user list the source code which is well remarked for examples of command and data retrieval syntax. Also illustrated is error processing and GPIB protocol.

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4.6.1 AMBER 5500 SYSTEM EVALUATION PACKAGE FOR THE PC

Issue 2.0: June 6, 1985

This package allows the user to define a series of 5500 instrument tests, execute them under the control of the BASICA interpreter with the National Instruments GPIB-PC BASICA Language Interface and have an Evaluation Report, consisting of measurement results and test analyses, displayed to the screen or printer.

PREREQUISITES

BASICA Interpreter

National Instruments GPIB-PC Interface with 5500 GPIB device, "A5500", and GPIB-PC interface board, "GPIB0", configured and installed. Refer to the National Instruments manual and to the IBCONF listings of the GPIB0 board and the A5500 device configuration enclosed with this document.

PACKAGE COMPONENTS

The following files are all included on the disk. Note that this program uses version B of the National Instruments software. Some difficulties have been reported with the latest version C of this software.

README.DOC is a general description and instruction text. Recommended reading.

T5500.BAS is a BASICA program which accepts a series of test configurations (up to 100), sets up the 5500, executes the specified tests and reports the results to the screen or printer. To run T5500 from DOS, enter BASICA T5500; to run it from BASICA, first LOAD "T5500" then enter RUN. T5500 prompts the user for the name of a Test Series Configuration data file. If no file name is entered, data must be entered via the keyboard, otherwise data will be read from the named file. Refer to Test Series Configuration below for a detailed description of the input data required. Data files must be unformatted ASCII text files, should be included in the GP5500 directory and suffixed .DAT.

MKDATA.BAS is a BASICA program which creates test data files for T5500. To run MKDATA from DOS, enter BASICA MKDATA; to run it from BASICA, first load "MKDATA" then enter RUN. MKDATA prompts the user for the name of the file to be created which should be suffixed .DAT.

After acquiring Test Series Identification data, it will prompt the user for Test Specification data starting with Command String Sequence. If no data is entered, the data file is closed and MKDATA terminates. Refer to Test Series Configuration below for a more detailed description of input data.

4.6.2 TEST SERIES CONFIGURATION

Test configuration data may be entered via the keyboard or read from a data file at T5500 run-time. Data files may be created using MKDATA or with any word processor. All data files must be ASCII text files of the form:

Test Identification record

Instrument Identification record

Report Format & Destination record

General remarks record

Test Specification blocks - where Test Specification block refers to the following set of records:

Command String Sequence record

Reference Specification record

Reference (Measurement) Units Display record

Criteria Specification record

Criteria (Deviation) Units Display record

Comments record

All records are ASCII strings delimited by quotes and there the number of Test Specification blocks must be between 1 and 100. Record types are described below. SAMPL.DAT, below, is an example of a valid test data file. When entering data on the keyboard from T5500 or MKDATA, the quotes are omitted.

4.6.3 TEST SERIES IDENTIFICATION RECORDS

Test Identification is the label associated with the test series that is used in the Evaluation Report header. This string is limited to 60 characters.

Instrument Identification is a label associated with the particular instrument under test, i.e. serial number that is used in the Evaluation Report header. This string is limited to 60 characters.

Report Format and Destination designates the printer or the screen as the output device and selects long or short report formats. Choices include "PA", "PF", "SA", and "SF" where "P" selects the printer, "S" the screen, "A" indicates that all individual test results should be displayed, and "F" that only the results of those tests which failed should be displayed.

General Remarks refers to any comments which should be part of the Evaluation Report Summary. This string is limited to 256 characters.

4.6.4 TEST SPECIFICATIONS REPORTS

Command String Sequence is a string of valid 5500 GPIB commands used to configure the instrument to a known state prior to executing any measurements. T5500 initializes the instrument to its default state by issuing a DCL bus command before it begins the test series; it, however, does not re-initialize the instrument after each test. This string is limited to 256 characters. A null command string sequence will cause T5500 to output the Evaluation Report and quit. A "/" command string sequence will cause T5500 to start executing measurements without reconfiguring the instrument.

Reference Specification is the numeric string which represents the actual value, regardless of units, to which measurement results will be compared. It is up to the user to make sure that the implied reference units correspond to the currently selected units in which measurement data is being returned by the 5500. If "/" is entered as the reference specification, the reference specification and reference (measurement) units display are carried over from the last test specification or a default of 0.1 and V.

Reference (Measurement) Units Display indicates the units display which is to accompany the Evaluation Reports measurement and reference data displays. Data is not converted to fit the units display. Again, it is up to the user to make sure that the implied reference units correspond to the currently selected units in which measurement data is being returned by the 5500. If "/" is entered as reference specification, this record must be omitted.

Criteria Specification is a numeric string which represents the actual value to which the deviation between measurement and reference is to be compared, regardless of units. This string must be delimited by the test type specification which indicates under what circumstances the test will fail. There are currently 6 types of tests available:

"R"	fail if abs ((measurement / reference) - 1)) criteria
"R+"	fail if (measurement / reference) - 1) criteria
"R-"	fail if (measurement / reference) - 1) criteria
"D"	fail if abs ((measurement - reference) criteria
"D+"	fail if (measurement - reference) criteria
"D-"	fail if (measurement - reference) criteria

where measurement is the data returned by the instrument after triggering measurement if it is not an error. If "/" is entered as the criteria specification, the criteria specification and criteria (deviation) units display are carried over from the last test specification.

Criteria (Deviation) Units Display indicates the units which will accompany the Evaluation Report's criteria and deviation displays. If "%" units are selected, criteria and deviation will be displayed 100 times the actual value specified and used in calculation. If "/" is entered as criteria specification, this record must be omitted.

Comments is a string of up to 256 characters which is used in the Evaluation Report at the top of the test results display.

4.6.5 SAMPLE TEST DATA FILE

File Name: SAMPL.DAT

"Sample Test"	Test Identification
"SN # 000000"	Instrument Identification
"SA"	Report Destination & Format
"This is an example"	General Remarks
"io o1 1.5vl"	Command String Sequence
"1.5"	Reference Specification
"V"	Reference (Measurement) Display
".01R+"	Criteria Specification
"%"	Criteria (Deviation) Display
"Test # 1"	Comments
"1.8vl"	Command String Sequence
"/"	Reference Specification Reference (Measurement) Display
"/"	Criteria Specification Criteria (Deviation) Display
"Test # 2"	Comments

Following is the Evaluation Report produced by T5500.BAS SAMPL.DAT.

4.6.6 5500 SYSTEM EVALUATION REPORT

Test ID : Sample
Test Instrument ID : SN # 000000
Date : 10-10-1984

Test # 1

Command Sequence: io o1 1.5vl

Measurement : 1.5 V

Reference : 1.5 V

Fail Criteria : (measurement/reference - 1 >1%

Analysis : Passed with a deviation of 0%

Start Time : 14:51:21

Stop Time : 14:51:25

Readings :

1. Error 12
2. Error 12
3. Error 12
4 Error 22
5. Error 11
6. Error 11
7. 1.56 V
8. 1.51 V
10. 1.5 V
11. 1.5 V

4.6.7 5500 SYSTEM EVALUATION REPORT

Test ID : Sample Test
Instrument ID : SN # 000000
Date : 10-10-1984

Test # 2

Command Sequence: 1.8vl

Measurement : 1.79 V

Reference : 1.5 V

Fail Criteria : (measurement/reference - 1 >1%

Analysis : Failed with a deviation of 19.33333%

Start Time : 14:51:26

Stop Time : 14:51:35

Readings :

1. 1.79 V
2. 1.8 V
3. 1.8 V
4. 1.8 V
5. 1.79 V
6. 1.79 V
7. 1.79 V
8. 1.79 V
9. 1.79 V
10. 1.79 V
11. 1.79 V
12. 1.79 V
13. 1.79 V
14. 1.79 V
15. 1.79 V
16. 1.79 V
17. 1.79 V
18. 1.79 V
19. 1.79 V
20. 1.79 V

4.6.8 5500 SYSTEM EVALUATION REPORT

Test ID : Sample Test
Instrument ID : SN # 000000
Date : 10-10-1984

SUMMARY

Start Time : 14:51:20

Stop Time : 14:51:35

Execution Status : 2 measurement(s) attempted
Test completed with no errors generated

Analysis : Of 2 measurement test(s) performed , 1 failed and 1 passed

Remarks : This is an example

4.6.9 IBCONF LISTINGS

```
CONFIGURED BEFORE PROCEEDING WITH THIS PROGRAM

Press RETURN to begin.

>>>>

Scanning file GPIB.COM . . . reading data . . .completed.

2 Board(s) 16 Device(s)

==============================================

DEFINE SYSTEM WIDE PARAMETERS (effective for all boards)

==============================================

PARAMETER                DEFAULT                 NEW VALUE
______________________________________________________________

Reference Clock Frequency? (decimal) . . . . [ 8 MHz] . . . . . . .>

Disable Automatic Serial Polling? . . . . . . . [ no] . . . . . .>

==============================================

You may now proceed with board and device level configurations.

If you need help, type HELP.

cmd>
```

```
==================================================================

NAME: GPIB0                                          NUMBER: B 0

==================================================================

      ( 1) Primary GPIB Address.................................. 00H
      ( 2) Secondary GPIB Address................................ 0:none
      ( 3) Timeout setting....................................... 13
      ( 4) EOS byte.............................................. 00H
      ( 5) EOS modes............................................. none
      ( 6) Board Options......................................... ( SC EOT )
      ( 7) Port Address.......................................... 02B8H
      ( 8) DMA channel........................................... 1
      ( 9) High-speed timing..................................... OFF

Footnotes:

      SC            Board is System Controller.
      EOT           Send EOI w/last byte of write.
      REOS          Terminate read on EOS.
      XEOS          Send EOI with EOS byte.
      BIN           Use 8-bit compare on EOS.
      nnH           Hexadecimal number.


==================================================================

cmd>
```

```
==================================================

NAME: A5500 ACCESS: GPIB0                    NUMBER: D 0

==================================================

      ( 1) Primary GPIB Address.................. 1CH
      ( 2) Secondary GPIB Address................ 0:none
      ( 3) Timeout setting....................... 13
      ( 4) EOS byte.............................. 0AH
      ( 5) EOS modes............................. ( REOS )
      ( 6) Device Options........................ ( EOT )

Footnotes:

      EOT Send EOI w/last byte of write.
      REOS Terminate read on EOS.
      XEOS Send EOI with EOS byte.
      BIN Use 8-bit compare on EOS.
      nnH Hexadecimal number.


==================================================

cmd >
```

```
10 REM ***************************************************************
20 REM Make T5500 Data File - MKDATA - Version #40 - Oct 10'84
30 REM ***************************************************************
40 INPUT "Enter T5500 data file name "; FLNM$
50 REM If null string entered, exit
60 IF FLNM$ = "" THEN GOTO 320
70 REM Create & open file for output
80 OPEN "O",1,FLNM$
90 INPUT "Enter Test Identification";T$
100 INPUT "Enter Instrument Identification";I$
110 INPUT "Enter Report Destination & Format: SA/SF/PA/PF";R$
120 INPUT "Enter General Remarks";C$
130 PRINT #1,CHR$(34);T$;CHR$(34);CHR$(34);I$;CHR$(34);CHR$(34);R$;CHR$(34);CHR$
(34);C$;CHR$(34)
140 INPUT "Enter 5500 GPIB Command String Sequence";CS$
150 IF CS$ = "" THEN GOTO 310 ELSE PRINT #1,CHR$(34);CS$;CHR$(34)
160 INPUT "Enter Reference Specification (default is /)";RF$
170 IF (RF$ <> "/") AND (RF$ <> "") THEN GOTO 200
180 PRINT #1,CHR$(34);"/";CHR$(34)
190 GOTO 220
200 INPUT "Enter Reference (Measurement) Units Display";RU$
210 PRINT #1,CHR$(34);RF$;CHR$(34);CHR$(34);RU$;CHR$(34)
220 INPUT "Enter Criteria Specification (default is /)";CR$
230 IF (CR$ <> "/") AND (CR$ <> "") THEN GOTO 260
240 PRINT #1,CHR$(34);"/";CHR$(34)
250 GOTO 280
260 INPUT "Enter Criteria (Deviation) Units Display";CU$
270 PRINT #1,CHR$(34);CR$;CHR$(34);CHR$(34);CU$;CHR$(34)
280 INPUT "Enter Comments";CM$
290 PRINT #1,CHR$(34);CM$;CHR$(34)
300 GOTO 140
310 CLOSE #1
320 END
```

```
10 REM   *******************************************************************
20 REM   5500 Evaluation Test - T5500 - Version #60 - Oct 10'84
30 REM   *******************************************************************
40 REM   *******************************************************************
50 REM   GPIB controller initialization sequence
60 REM   *******************************************************************
70         CLEAR   ,58000!          ' GPIB-PC Rev. B.1
80         IBINIT1 = 58000!         ' BASICA Declaration File
90         IBINIT2 = IBINIT1 + 3    '
100         BLOAD "bib.m",IBINIT1
110         CALL IBINIT1(IBFIND,IBTRG,IBCLR,IBPCT,IBSIC,IBLOC,IBPPC,IBBNA,IBONL,I
BRSC,IBSRE,IBRSV,IBPAD,IBSAD,IBIST,IBDMA,IBEOS,IBTMO,IBEOT)
120         CALL IBINIT2(IBGTS,IBCAC,IBWAIT,IBPOKE,IBWRT,IBWRTA,IBCMD,IBCMDA,IBRD
,IBRDA,IBSTOP,IBRPP,IBRSP,IBDIAG,IBXTRC,IBSTA%,IBERR%,IBCNT%)
130  REM   *******************************************************************
140  REM   Main initialization sequence
150  REM   *******************************************************************
160 REM   Test declarations & initialization sequence
170 GOSUB 1270
180 REM   Find device (A5500) & board (GPIB0) identifiers
190 REM   Define GPIB read termination criteria & timeout
200 GOSUB 810
210 REM   If error generated, report & quit
220 IF ECODE <> 0 THEN GOTO 590
230 REM   Clear interface & instrument ( to default state)
240 REM   Put instrument into RWLS state, HOLD mode & select all SRQ conditions
250 GOSUB 1020
260 REM   If error generated, report & quit
270 IF ECODE <> 0 THEN GOTO 590
280 REM   Clear 5500 GPIB input buffer
290 GOSUB 6010
300 IF ECODE <> 0 THEN GOTO 590
310 REM   Start time
320 SSTRT$ = TIME$
330 REM   *******************************************************************
340 REM   Main loop: execute command sequences & measure
350 REM   *******************************************************************
360 REM   Get configuration data: command string, reference & test criteria
370 REM   Initialize test variables
380 GOSUB 1760
390 REM   If no more data, report & quit
400 IF NOMORE THEN GOTO 590
410 REM   If error generated, report & quit
420 IF ECODE <> 0 THEN GOTO 590
430 REM   Start time
440 TSTRT$(TCNT) = TIME$
450 REM   Trigger measurement, collect & evaluate results
```

```
460 GOSUB 2480
470 REM   If error generated, report & quit
480 IF ECODE <> 0 THEN GOTO 520
490 REM   If settling criteria satisfied, then next test, else try again
500 IF SETTLED = 0 THEN GOTO 460
510 IF MSTATS(TCNT) = 0 THEN FCNT = FCNT + 1 ELSE PCNT = PCNT + 1
520 REM   Stop time
530 TSTOP$(TCNT) = TIME$
540 REM   Next test
550 IF ECODE = 0 THEN GOTO 360
560 REM   ********************************************************************
570 REM   Report & exit
580 REM   ********************************************************************
590 SSTOP$ = TIME$
600 IF IMODE = 2 THEN CLOSE #1
610 REM   If reported error = Device Find, Board Find, IFC, Remote
620 REM  Enable, Remote Disable, Sending Listen Address, Invalid Test Data
630 REM  do not attempt to clear instrument or return to LOCS state
640 IF (ECODE <> 0) AND (ECODE <= 6) THEN GOTO 740
650 REM   If reported error = SDC, LLO
660 REM  do not attempt to clear instrument
670 IF (ECODE = 7) OR (ECODE = 8) THEN GOTO 720
680 REM   Clear instrument to default machine status
690  CALL IBCLR(DVM%)
700 REM   Clear instrument to default machine status
710  CALL IBCLR(DVM%)
720 REM   Return instrument to LOCS state
730 V% = 0 : CALL IBSRE(BRD0%,V%)
740 REM   Report measurement test results on screen or printer
750 GOSUB 2700
760 END
770 REM   **********************SUBROUTINES**********************************
780 REM   *******************************************************************
790 REM   Find device (A5500) & board (GPIB0) identifiers
800 REM   ********************************************************************
810 DEV$ = "A5500" : BDNAME$ = "GPIB0"
820 REM   Set ECODE to Device Find Failed error
830 ECODE = 1
840 CALL IBFIND(DEV$,DVM%)
850 REM   Trap Device Find Failed error
860 IF DVM% < 0 THEN GOTO 980
870 REM   Set ECODE to Board Find Failed error
880 ECODE = 2
890 CALL IBFIND(BDNAME$,BRD0%)
900 REM   Trap Board Find Failed error
910 IF BRD0% < 0 THEN GOTO 980
920 REM Set timeout to 10 sec
```

```
930 V% = 13 : CALL IBTMO(DVM%,V%)
940 REM Set read termination criteria to EOS & EOS to <LF>
950 V% = &H400 + &HA : CALL IBEOS (DVM%,V%)
960 REM   Clear ECODE
970 ECODE = 0
980 RETURN
990 REM   ********************************************************************
1000 REM   Board IFC, LLO, SDC, put instrument in HOLD & select all SRQ
1010 REM   ********************************************************************
1020 REM   Execute IFC
1030 ECODE = 3
1040 CALL IBSIC(BRD0%)
1050 IF IBSTA% < 0 THEN GOTO 1230
1060 REM   Put instrument in REMS state: Remote enable
1070 ECODE = 4
1080 V% = 1 : CALL IBSRE(BRD0%,V%)
1090 IF IBSTA% < 0 THEN GOTO 1230
1100 REM   Put instrument in RWLS state: assert LLO
1110 ECODE = 8
1120 CMD$ = CHR$(&H11) : CALL IBCMD(BRD0%,CMD$)
1130 IF IBSTA% < 0 THEN GOTO 1230
1140 REM   Clear instrument to default state: assert SDC
1150 ECODE = 7
1160 CALL IBCLR(DVM%)
1170 IF IBSTA% < 0 THEN GOTO 1230
1180 REM   Put instrument in 'Hold Mode' & select all SRQ conditions
1190 ECODE = 10
1200 WRT$ = "T122.2SP" : CALL IBWRT(DVM%,WRT$)
1210 IF IBSTA% < 0 THEN GOTO 1230
1220 ECODE = 0
1230 RETURN
1240 REM   ********************************************************************
1250 REM   Declarations & initialization
1260 REM   ********************************************************************
1270 DIM BUFR$(100,20)     'instrument message buffer
1280 DIM CMDSTR$(100)      'command string buffer
1290 DIM REF!(100)         'reference buffer
1300 DIM RUNITS$(100)       'measurement & reference units
1310 DIM CRTRIA!(100)      'fail criteria buffer
1320 DIM TTYP(100)         'test type buffer
1330 DIM MSTATS(100)       'measurement status
1340 DIM MARGIN!(100)       'PASS/FAIL MARGIN
1350 DIM CUNITS$(100)       'criteria units
1360 DIM MCNT(100)         'measurement counter buffer
1370 DIM TSTRT$(100)       'measurement start time buffer
1380 DIM TSTOP$(100)       'measurement stop time buffer
```

```
1390 DIM NOTES$(100)       'comments
1400 REM   Test constants:
1410 SETLCNT = 3           '# of consecutive in range measurements re: settling
1420 MAXTRIG = 20          '# of measurement attempts before test fails
1430 SRNGE! = .1           'settling range
1440 SPMAX = 100            '# of serial polls before test fails
1450 REM   Test variables initialization:
1460 TCNT = 0              'test counter
1470 NOMORE = 0            'no more test data flag
1480 ECODE = 0
1490 FCNT = 0 : PCNT = 0    'pass/fail counters
1500 REM   Test data input initialization
1510 REM   Collect data file name
1520 INPUT "Test data file "; INNAME$
1530 REM   If user response is null, data entered via keyboard
1540 IF INNAME$ = "" THEN IMODE = 1 ELSE IMODE = 2
1550 ON IMODE GOSUB 1640,1570
1560 RETURN
1570 OPEN "I",1,INNAME$
1580 REM   Get test identification from input file
1590 INPUT #1,TESTNM$,INSTRNM$,RMODE$
1600 REM   Get comments
1610 GOSUB 4810
1620 SNOTES$ = ANOTE$
1630 RETURN
1640 REM   Get test identification from keyboard
1650 INPUT "Test identification"; TESTNM$
1660 REM   Get instrument identification
1670 INPUT "Instrument identification";INSTRNM$
1680 REM   Report destination
1690 INPUT "Report to screen (S) or printer (P)"; RMODE$
1700 REM   General comments
1710 INPUT "General remarks";SNOTES$
1720 RETURN
1730 REM   ********************************************************************
1740 REM   Initialize test, get configuration data & send command string
1750 REM   ********************************************************************
1760 TCNT = TCNT + 1
1770 MCNT(TCNT) = 0  'total # of attempted measurements
1780 MSTATS(TCNT) = 0  'initial status = failed
1790 SFLAG = 0       '# consecutive in range measurements
1800 SETTLED = 0     'settled measurement flag
1810 REM   Read commands, reference & criteria from keyboard or data file
1820 ON IMODE GOSUB 5020,4900
1830 IF NOMORE = 0 THEN GOTO 1850
1840 TCNT = TCNT - 1 : RETURN
1850 IF CMDSTR$(TCNT) = "/" THEN GOTO 1890
```

```
1860 ECODE = 10
1870 CALL IBWRT(DVM%,CMDSTR$(TCNT))
1880 IF IBSTA% < 0 THEN GOTO 2180
1890 REM   Convert reference & save it
1900 IF REFSTR$ <> "/" THEN GOTO 1960
1910 IF TCNT <= 1 THEN GOTO 1940
1920 REF!(TCNT) = REF!(TCNT-1) : RUNITS$(TCNT) = RUNITS$(TCNT-1)
1930 GOTO 1970
1940 REF!(TCNT) = .1 : RUNITS$(TCNT) = "V"
1950 GOTO 1970
1960 REF!(TCNT) = VAL(REFSTR$)
1970 REM   Check whether criteria valid & save value
1980 IF CRTSTR$ <> "/" THEN GOTO 2040
1990 IF TCNT <= 1 THEN GOTO 2020
2000 CRTRIA!(TCNT) = CRTRIA!(TCNT-1) : TTYP(TCNT) = TTYP(TCNT-1)
2010 CUNITS$(TCNT) = CUNITS$(TCNT-1) : GOTO 2170
2020 CRTRIA!(TCNT) = .1 : TTYP(TCNT) = 1
2030 CUNITS$(TCNT) = "%" : GOTO 2170
2040 REM   Determine type of evaluation to be done on data
2050 TTYP(TCNT) = 1 : ECODE = 12
2060 CRTRIA!(TCNT) = VAL(CRTSTR$)
2070 I = 1 : L = LEN (CRTSTR$)
2080 M$ = MID$(CRTSTR$,I,1)
2090 IF (M$ = "R") OR (M$ = "r") OR (M$ = "D") OR (M$ = "d") THEN GOTO 2120
2100 I = I + 1
2110 IF I > L THEN GOTO 2180 ELSE GOTO 2080
2120 IF (M$ = "D") OR (M$ = "d")  THEN TTYP(TCNT) = 4
2130 IF I = L THEN GOTO 2170
2140 M$ = MID$(CRTSTR$,I+1,1) : TTYP(TCNT) = TTYP(TCNT) + 1
2150 IF (M$ <> "-") AND (M$ <> "+") THEN GOTO 2180
2160 IF M$ = "-" THEN TTYP(TCNT) = TTYP(TCNT) + 1
2170 IF (TTYP(TCNT) <= 3) AND (REF!(TCNT) = 0) THEN ECODE = 11 ELSE ECODE = 0
2180 RETURN
2190 REM   ***********************************************************************
2200 REM   Read instrument messages & report read error if it occurs
2210 REM   ***********************************************************************
2220 ECODE = 9
2230 RD$ = SPACE$(12) : CALL IBRD(DVM%,RD$)
2240 REM   If read error detected then return Read Failed error
2250 IF (IBSTA% AND &H8000) <> 0 THEN GOTO 2270
2260 ECODE = 0
2270 RETURN
2280 REM   ********************************************************************
2290 REM   Serial poll
2300 REM   ********************************************************************
2310 ECODE = 15
2320 SPCNTR = 0
```

```
2330 SPR% = 0
2340 CALL IBRSP(DVM%,SPR%)
2350 REM  If B6 of SPR not set, device not requesting service
2360 IF (SPR% AND &H40) <> 0 THEN GOTO 2410
2370 REM  If device not requesting service, try again ( upto 20 times)
2380 SPCNTR = SPCNTR + 1
2390 IF SPCNTR < SPMAX THEN GOTO 2330
2400 RETURN
2410 REM  If device requesting service, only B2..B0 relevant
2420 SPR% = SPR% AND &H7
2430 ECODE = 0
2440 RETURN
2450 REM   ***********************************************************************
2460 REM  Trigger measurement & read results
2470 REM   ***********************************************************************
2480 ECODE = 13
2490 CALL IBTRG(DVM%)
2500 IF IBSTA < 0 GOTO 2660
2510 REM   Serial poll device
2520 GOSUB 2310
2530 REM   If serial poll failed, exit
2540 IF ECODE <> 0 THEN GOTO 2660
2550 REM   Read instrument message
2560 GOSUB 2200
2570 IF ECODE <> 0 THEN GOTO 2660
2580 REM   If fatal instrument error returned, then exit
2590 ECODE = 14
2600 IF (SPR% AND &H4) <> 0 THEN GOTO 2660
2610 ECODE = 0
2620 MCNT(TCNT) = MCNT(TCNT) + 1
2630 BUFR$(TCNT,MCNT(TCNT)) = RD$
2640 REM   Evaluate results
2650 GOSUB 4170
2660 RETURN
2670 REM   ***********************************************************************
2680 REM   Report test results on screen or printer
2690 REM   ***********************************************************************
2700 RFLAG = 1 : AFLAG = 1         'intialize report flags to screen/all
2710 R1$ = MID$(RMODE$,1,1) : R2$ = MID$(RMODE$,2,1)
2720 IF (R1$ = "p") OR (R1$ = "P") THEN RFLAG = 2
2730 IF (R2$ = "f") OR (R2$ = "F") THEN AFLAG = 2
2740 LASTP = 0                         'last page flag
2750 REM   Build page header
2760 DIM HDR$(11) : DIM EVAL$(25)
2770 IF TESTNM$ = "/" THEN TESTNM$ = ""
2780 IF INSTRNM$ = "/" THEN INSTRNM$ = ""
```

```
2790 ON RFLAG GOSUB 5240,5340
2800 REM   Report individual test results
2810 IF TCNT = 0 THEN 3200
2820 FOR I = 1 TO TCNT STEP 1
2830 REM   Measurement evaluation
2840 IF (AFLAG = 2) AND (MSTATS(I) = 1) THEN GOTO 3190
2850 GOSUB 3250
2860 IF CMDSTR$(I) = "/" THEN CMDSTR$(I) = ""
2870 CMTSTR$ = "Command Sequence:   " + CMDSTR$(I)
2880 GOSUB 5790
2890 EL = 5
2900 FOR J = 1 TO 4 STEP 1
2910 EVAL$(EL) = CSTR$(J)
2920 EL = EL + 1
2930 NEXT J
2940 EVAL$(9) = "Measurement:" + SPACE$(7) + MSMSTR$
2950 EVAL$(10) = "Reference:" + SPACE$(9) + REFSTR$
2960 EVAL$(11) = "Fail Criteria:" + SPACE$(6) + CRTSTR$
2970 EVAL$(12) = "Analysis:" + SPACE$(11) + ANLYS$
2980 EVAL$(13) = "Start Time:" + SPACE$(9) + TSTRT$(I)
2990 EVAL$(14) = "Stop Time:" + SPACE$(10) + TSTOP$(I)
3000 EVAL$(15) = "Readings:"
3010 EL = 16 : J = 1 : JMAX = CINT(CSNG(MCNT(I))/2!)
3020 IF MCNT(I) => 10 THEN JMAX = 10 ELSE JMAX = MCNT(I)
3030 IF J > JMAX THEN GOTO 3100
3040 GOSUB 4430
3050 S1$ = SPACE$(10-LEN(NUM1$)) : S2$ = SPACE$(30-LEN(RDNG1$))
3060 S3$ = SPACE$(10-LEN(NUM2$))
3070 EVAL$(EL) = NUM1$ + S1$ + RDNG1$ + S2$ + NUM2$ + S3$ + RDNG2$
3080 EL = EL + 1 : J = J + 1
3090 GOTO 3030
3100 IF EL = 26 THEN GOTO 3130
3110 EVAL$(EL) = ""
3120 EL = EL + 1 : GOTO 3100
3130 CMTSTR$ = NOTES$(I)
3140 GOSUB 5790
3150 FOR J = 1 TO 4 STEP 1
3160 EVAL$(J) = CSTR$(J)
3170 NEXT J
3180 ON RFLAG GOSUB 3930,3800
3190 NEXT I
3200 REM   Display overall evaluation
3210 LASTP = 1
3220 GOSUB 5530
3230 RETURN
3240 REM   ******************************************************************
3250 REM   Evaluate test results
```

```
3260 REM   *****************************************************************
3270 IF (I <> TCNT) OR (ECODE < 9) THEN GOTO 3310
3280 MSMSTR$ = "Not Available" : ANLYS$ = STATUS$
3290 IF ECODE <> 12 THEN GOTO 3380
3300 CRTSTR$ = "Invalid" : GOTO 3440
3310 REM   Build measurement display string
3320 MSMSTR$ = STR$(VAL(BUFR$(I,MCNT(I)))) + " " + RUNITS$(I)
3330 REM   Build analysis string
3340 IF MSTATS(I) = 0 THEN A$ = "Failed" ELSE A$ = "Passed"
3350 IF CUNITS$(I) = "%" THEN C! = MARGIN!(I) * 100! ELSE C! = MARGIN!(I)
3360 ANLYS$ = A$ + " with a deviation of " + STR$(ABS(C!)) + " " + CUNITS$(I)
3370 REM   Build ctriteria string
3380 IF TTYP(I) > 3 THEN A$ = "(measurement - reference)" ELSE A$ = "(measuremen
t/reference - 1)"
3390 IF CUNITS$(I) = "%" THEN C! = CRTRIA!(I) * 100! ELSE C! = CRTRIA!(I)
3400 B$ = STR$(C!) + " " + CUNITS$(I)
3410 IF (TTYP(I) = 1) OR (TTYP(I) = 4) THEN CRTSTR$ = "abs" + A$ + " > " + B$
3420 IF (TTYP(I) = 2) OR (TTYP(I) = 5) THEN CRTSTR$ = A$ + " > " + B$
3430 IF (TTYP(I) = 3) OR (TTYP(I) = 6) THEN CRTSTR$ = A$ + " < " + B$
3440 IF ECODE = 11 THEN REFSTR$ = "Invalid" ELSE REFSTR$ = STR$(REF!(I)) + " " +
 RUNITS$(I)
3450 RETURN
3460 REM   *****************************************************************
3470 REM   Set DEVTN! to the difference between measurement & reference
3480 REM   *****************************************************************
3490 DEVTN! = MSMNT! - REF!(TCNT)
3500 RETURN
3510 REM   *****************************************************************
3520 REM   Set DEVTN! to the ratio of deviation measurement to reference
3530 REM   *****************************************************************
3540 DEVTN! = (MSMNT! / REF!(TCNT)) - 1
3550 RETURN
3560 REM   *****************************************************************
3570 REM   Fail if measurement result not in range
3580 REM   *****************************************************************
3590 MRGN! = ABS(DEVTN!) - CRTRIA!(TCNT)
3600 MARGIN!(TCNT) = ABS(DEVTN!)
3610 IF MRGN! > 0! THEN MSTATS(TCNT) = 0 ELSE MSTATS(TCNT) = 1
3620 RETURN
3630 REM   *****************************************************************
3640 REM   Fail if measurment result too large
3650 REM   *****************************************************************
3660 MRGN! = DEVTN! - CRTRIA!(TCNT)
3670 MARGIN!(TCNT) = ABS(DEVTN!)
3680 IF MRGN! > 0 THEN MSTATS(TCNT) = 0 ELSE MSTATS(TCNT) = 1
3690 RETURN
```

```
3700 REM   ******************************************************************
3710 REM   Fail if measurement result too small
3720 REM   ******************************************************************
3730 MRGN! = DEVTN! - CRTRIA!(TCNT)
3740 MARGIN!(TCNT) = ABS(DEVTN!)
3750 IF MRGN! < 0 THEN MSTATS(TCNT) =0 ELSE MSTATS(TCNT) = 1
3760 RETURN
3770 REM   ******************************************************************
3780 REM   Print test evaluation
3790 REM   ******************************************************************
3800 LPRINT CHR$(12)
3810 MID$(HDR$(2),PPNTR,2) = STR$(PNUM)
3820 FOR IJ = 1 TO 11 STEP 1
3830 LPRINT HDR$(IJ)
3840 NEXT IJ
3850 FOR IJ = 1 TO 25 STEP 1
3860 LPRINT SPACE$(5) + EVAL$(IJ)
3870 NEXT IJ
3880 IF PNUM = PMAX THEN LPRINT CHR$(12) ELSE PNUM = PNUM + 1
3890 RETURN
3900 REM   ******************************************************************
3910 REM    Write test evaluation to screen
3920 REM   ******************************************************************
3930 LN1 = 1                                      'first display line
3940 IF PNUM = PMAX THEN LN2 = 19 ELSE LN2 = 14   'last display line
3950 MID$(HDR$(1),PPNTR,2) = STR$(PNUM)
3960 PNUM = PNUM + 1
3970 FOR IJ = 1 TO 3 STEP 1
3980 PRINT HDR$(IJ)
3990 NEXT IJ
4000 FOR IJ = LN1 TO LN2 STEP 1
4010 PRINT EVAL$(IJ)
4020 NEXT IJ
4030 IF PNUM > PMAX THEN GOTO 4130
4040 FOR IJ = 1 TO (20 - ((LN2 - LN1) + 1)) STEP 1
4050 PRINT " "
4060 NEXT IJ
4070 INPUT "Continue";SCRQ$
4080 IF (SCRQ$ = "n") OR (SCRQ$ = "N") THEN GOTO 4120
4090 IF LN2 = 25 THEN GOTO 4130
4100 LN1 = 15 : LN2 = 25
4110 GOTO 3950
4120 END
4130 RETURN
4140 REM   ******************************************************************
4150 REM    Check for valid measurement results
4160 REM   ******************************************************************
```

```
4170 REM   Check whether data returned is an error
4180 IF (MID$(RD$,1,4) = "+900") AND (MID$(RD$,7,4) = "E+05") THEN GOTO 4370
4190 MSMNT! = VAL(RD$)
4200 REM   Check for settled measurement results
4210 IF TTYP(TCNT) <= 3 THEN TTYP1 = 1 ELSE TTYP1 = 2
4220 IF TTYP(TCNT) <= 3 THEN TTYP2 = TTYP(TCNT) ELSE TTYP2 = TTYP(TCNT) - 3
4230 REM   Calclate deviance
4240 ON TTYP1 GOSUB 3520,3470
4250 REM   Calculate analysis
4260 REM   Measurement relative to reference must be
4270 REM   Within specified range to pass, in the case of TTYP1 = 0
4280 REM   Below specified range to pass, in the case of TTYP1 = 1
4290 REM   Above specified range to pass, in the case of TTYP1 = 2
4300 ON TTYP2 GOSUB 3570,3640,3710
4310 IF MSTATS(TCNT) = 0 THEN GOTO 4370
4320 SFLAG = SFLAG + 1
4330 IF SFLAG < SETLCNT THEN GOTO 4380
4340 REM   Case of valid measurement reported & settling criteria passed
4350 SETTLED = 1
4360 RETURN
4370 SFLAG = 0
4380 IF MCNT(TCNT) => MAXTRIG THEN SETTLED = 1
4390 RETURN
4400 REM   *****************************************************************
4410 REM   Create "Readings:" display
4420 REM   *****************************************************************
4430 NUM1$ = STR$(J) + "." : R$ = BUFR$(I,J)
4440 GOSUB 4510 : RDNG1$ = R$
4450 IF MCNT(I) => (J+10) THEN GOTO 4480
4460 NUM2$ = "" : RDNG2$ = ""
4470 RETURN
4480 NUM2$ = STR$(J+10) + "." : R$ = BUFR$(I,J+10)
4490 GOSUB 4510 : RDNG2$ = R$
4500 RETURN
4510 IF (MID$(R$,1,4) = "+900") AND (MID$(R$,7,4) = "E+05") THEN GOTO 4540
4520 R$ = STR$(VAL(R$)) + " " + RUNITS$(I)
4530 RETURN
4540 R$ = "Error " + MID$(R$,5,2)
4550 RETURN
4560 REM   ******************************************************************
4570 REM   Create test status display
4580 REM   ******************************************************************
4590 IF ECODE <> 0 THEN GOTO 4610
4600 STATUS$ = "no errors generated" : RETURN
4610 ON ECODE GOTO 4620,4630,4640,4650,4660,4670,4680,4690,4700,4710,4720,4730,4
740,4750,4760,4770
4620 STATUS$ = "device find failure" : RETURN
```

```
4630 STATUS$ = "board find failure" : RETURN
4640 STATUS$ = "IFC failure" : RETURN
4650 STATUS$ = "remote enable failure" : RETURN
4660 STATUS$ = "listen address failure" : RETURN
4670 STATUS$ = "remote disable failure" : RETURN
4680 STATUS$ = "SDC failure" : RETURN
4690 STATUS$ = "LLO failure" : RETURN
4700 STATUS$ = "read failure" : RETURN
4710 STATUS$ = "write failure" : RETURN
4720 STATUS$ = "invalid reference" : RETURN
4730 STATUS$ = "invalid criteria" : RETURN
4740 STATUS$ = "trigger failure" : RETURN
4750 STATUS$ = "fatal instrument error " + MID$(BUFR$(TCNT,MCNT(TCNT)),5,2) : RE
TURN
4760 STATUS$ = "instrument not resquesting service" : RETURN
4770 STATUS$ = "measurement settling failure" : RETURN
4780 REM   *****************************************************************
4790 REM   Get comments from input file # 1
4800 REM   *****************************************************************
4810 INPUT #1,ANOTE$
4820 IF RIGHT$(ANOTE$,1) <> "'" THEN GOTO 4860
4830 INPUT #1,BNOTE$
4840 ANOTE$ = MID$(ANOTE$,1,LEN(ANOTE$)-1) + " " + BNOTE$
4850 GOTO 4820
4860 RETURN
4870 REM   *****************************************************************
4880 REM   Get configuration data from input file # 1
4890 REM   *****************************************************************
4900 IF EOF(1) THEN GOTO 4980
4910 INPUT #1,CMDSTR$(TCNT),REFSTR$
4920 IF REFSTR$ <> "/" THEN INPUT #1,RUNITS$(TCNT)
4930 INPUT #1,CRTSTR$
4940 IF CRTSTR$ <> "/" THEN INPUT #1,CUNITS$(TCNT)
4950 GOSUB 4810
4960 NOTES$(TCNT) = ANOTE$
4970 RETURN
4980 NOMORE = 1 : RETURN
4990 REM   *****************************************************************
5000 REM   Get configuration data from keyboard
5010 REM   *****************************************************************
5020 INPUT "Enter command string";CMDSTR$(TCNT)
5030 IF CMDSTR$(TCNT) = "" THEN GOTO 5230
5040 INPUT "Enter reference";REFSTR$
5050 INPUT "Enter criteria";CRTSTR$
5060 INPUT "Enter comments";NOTES$(TCNT)
5070 REM   Extract reference units from REFSTR if not /
5080 IF REFSTR$ = "/" THEN GOTO 5140
```

```
5090 RI = 1 : RL = LEN(REFSTR$)
5100 IF MID$(REFSTR$,RI,1) = " " THEN GOTO 5130
5110 RI = RI + 1
5120 IF RI < RL THEN GOTO 5100
5130 IF RI <> RL THEN RUNITS$(TCNT) = MID$(REFSTR$,RI+1,RL-RI)
5140 REM   Extract criteria units from CRTSTR if not /
5150 IF CRTSTR$ = "/" THEN GOTO 5220
5160 CI = 1 : CL = LEN(CRTSTR$)
5170 IF MID$(CRTSTR$,CI,1) = " " THEN GOTO 5200
5180 CI = CI + 1
5190 IF CI < CL THEN GOTO 5170
5200 IF CI <> CL THEN CUNITS$(TCNT) = MID$(CRTSTR$,CI+1,CL-CI)
5210 IF CI < CL THEN CRTSTR$ = MID$(CRTSTR$,1,CI-1)
5220 RETURN
5230 NOMORE = 1 : RETURN
5240 REM   ******************************************************************
5250 REM   Build screen header & initialize screen variables
5260 REM   ******************************************************************
5270 PMAX = (2 * TCNT) + 1             'total pages
5280 PNUM = 1                    'current page
5290 PPNTR = 65                  'page number position
5300 HDR$(1) = SPACE$(60) + "page 1  / " + STR$(PMAX)
5310 HDR$(2) = "Test ID:" + SPACE$(12) + TESTNM$
5320 HDR$(3) = "Instrument ID:" + SPACE$(6) + INSTRNM$
5330 RETURN
5340 REM   ******************************************************************
5350 REM   Build print header & initialize print variables
5360 REM   ******************************************************************
5370 PMAX = TCNT + 1                   'total pages
5380 PNUM = 1                          'current page
5390 PPNTR = 65                        'page number position
5400 HDR$(1) = ""
5410 HDR$(2) = SPACE$(60) + "page 1 of" + STR$(PMAX)
5420 HDR$(3) = ""
5430 HDR$(4) = SPACE$(25) + "5500 SYSTEM EVALUATION REPORT"
5440 HDR$(5) = ""  : HDR$(6) = ""
5450 HDR$(7) = SPACE$(5) + "Test ID:" + SPACE$(12) + TESTNM$
5460 HDR$(8) = SPACE$(5) + "Instrument ID:" + SPACE$(6) + INSTRNM$
5470 HDR$(9) = SPACE$(5) + "Date:" + SPACE$(15) + DATE$
5480 HDR$(10) = "" : HDR$(11) = ""
5490 RETURN
5500 REM   ******************************************************************
5510 REM   Display overall evaluation
5520 REM   ******************************************************************
5530 EVAL$(1) = "" : EVAL$(2) = ""
5540 EVAL$(3) = SPACE$(35) + "SUMMARY"
5550 EVAL$(4) = ""
```

```
5560 EVAL$(5) = "Start Time: " + SPACE$(8) + SSTRT$ : EVAL$(6) = ""
5570 EVAL$(7) = "Stop Time: " + SPACE$(9) + SSTOP$ : EVAL$(8) = ""
5580 EVAL$(9) = "Execution Status:  " + STR$(TCNT) + " measurement(s) attempted"
5590 STATS$ = SPACE$(20)
5600 IF ECODE = 0 THEN STATS$ = STATS$ + "Test completed with " ELSE STATS$ = ST
ATS$ + "Test aborted due to "
5610 GOSUB 4570
5620 EVAL$(10) = STATS$ + STATUS$ : EVAL$(11) = ""
5630 EVAL$(12) = "Analysis:" + SPACE$(11) + "Of" + STR$(FCNT+PCNT) + " measureme
nt test(s) performed"
5640 EVAL$(13) = SPACE$(19) + STR$(FCNT) + " failed and" + STR$(PCNT) + " passed
"
5650 EVAL$(14) = "" : EVAL$(15) = "Remarks:"
5660 CMTSTR$ = "  " + SNOTES$
5670 GOSUB 5790 : CL = 1
5680 FOR EL = 16 TO 19 STEP 1
5690 EVAL$(EL) = CSTR$(CL) : CL = CL + 1
5700 NEXT EL
5710 FOR EL = 20 TO 25 STEP 1
5720 EVAL$(EL) = ""
5730 NEXT EL
5740 ON RFLAG GOSUB 3910,3780
5750 RETURN
5760 REM   *****************************************************************
5770 REM   Process comments
5780 REM   *****************************************************************
5790 CI = 1
5800 IF RIGHT$(CMTSTR$,1) = "/" THEN CMTSTR$ = MID$(CMTSTR$,1,LEN(CMTSTR$)-1)
5810 IF LEN(CMTSTR$) < 75 THEN GOTO 5930
5820 CL = 75
5830 CS$ = MID$(CMTSTR$,1,CL)
5840 IF RIGHT$(CS$,1) = " " THEN GOTO 5900
5850 CL = CL - 1
5860 IF CL > 0 THEN GOTO 5830
5870 CSTR$(CI) = MID$(CMTSTR$,1,74)
5880 CMTSTR$ = MID$(CMTSTR$,75,LEN(CMTSTR$)-74)
5890 GOTO 5920
5900 CSTR$(CI) = MID$(CMTSTR$,1,CL-1)
5910 CMTSTR$ = MID$(CMTSTR$,CL+1,LEN(CMTSTR$)-CL)
5920 CI = CI + 1 : GOTO 5810
5930 CSTR$(CI) = CMTSTR$
5940 FOR CJ = CI+1 TO 4 STEP 1
5950 CSTR$(CJ) = ""
5960 NEXT CJ
5970 RETURN
```

```
5980 REM   *****************************************************************
5990 REM   Clear 5500 GPIB input buffer
6000 REM   *****************************************************************
6010 REM   Clear status byte
6020 SPR% = 0
6030 CALL IBRSP(DVM%,SPR%)
6040 REM   Read instrument messages
6050 GOSUB 2220
6060 REM  If message returned, continue to read until no more messages
6070 IF ECODE = 0 THEN GOTO 6050
6080 IF (IBSTA% AND &H4000) = 0 THEN GOTO 6100
6090 ECODE = 0
6100 RETURN
```